FORTIFICATION

SIR GEORGE SYDENHAM CLARKE

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ITS PAST ACHIEVEMENTS, RECENT DEVELOPMENT, AND FUTURE PROGRESS

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WITH MAP OF PORT ARTHUR AND 57 ILLUSTRATIONS

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PREFACE TO SECOND EDITION

My first independent studies in Fortification began in 1879, when I undertook to produce a work on the memorable defence of Plevna. The labour and research thus involved necessarily led to many conclusions which in later years took definite form and assumed a wider scope. It seemed to me that Fortification was treated as a separate branch of military science capable of being understood only by experts, that formalism was rampant, and that it was necessary to seek for general principles based solely on the broad lessons of war.

The chances of life brought exceptional opportunities, not only of inspecting works of defence at home and abroad, but of gathering knowledge of the conditions and requirements of the Empire. Thus, the relations of Fortification to national policy became an absorbing study, in the light of which technical questions assumed subordinate importance.

The original germ from which the present work sprang was an official paper written in 1883, a year after I had made a detailed examination of the effects of the fire of our Mediterranean Fleet upon the defences of Alexandria. The substance of this paper was published in the Proceedings of the Royal Artillery Institution in 1886. Subsequently, after visiting Plevna in January, 1887, I wrote three articles

on Land Fortification for the same Institution. These four essays, with many additions, and notably a sketch of the evolution of warships, formed the basis of the First Edition.

Nearly eighteen years have now elapsed since my book was written, and while, with one brief exception, the peace of Europe has happily been maintained, there have been four wars—China-Japan, 1894; Spain-America, 1898; South Africa, 1899-1902; and Russia-Japan, 1904-1905—from which many direct and indirect lessons bearing on the varied problems of national defence can be drawn.

Meanwhile the currents of thought have formed new channels, and standpoints have changed. Some of the principles which I strove, perhaps too vehemently, to enforce in 1889 have now become commonplace views which were always known and accepted. I may not claim that my book, which on its first appearance was in many quarters regarded as dangerously heretical, has played any part in moulding opinion. I venture to think, however, that all the subsequent experience of war, culminating at Port Arthur, has strikingly justified the conclusions to which I was led.

While, therefore, I find little to modify, there are numerous passages which, if reprinted to-day, would appear to partake of the obvious. Moreover, with years and much thought, there comes a softening of the judgment, and some sentences—the echoes of strenuous controversies, long dead—now seem too harshly phrased.

New causes of warm dispute have, however, arisen, and I have found it impossible to avoid all contentious matter. The recent activity of the invasion-monger, in spite of the fact that relatively and absolutely the Royal Navy is now stronger than at any period in its wonderful history, is an unhealthy symptom. The growing tendency to treat as inspired the lucubrations of foreign military officers on purely naval questions, and generally to look abroad for authorita-

tive opinions in regard to purely British problems, indicates a distressing lack of self-reliance. I have, perhaps, again erred in giving rein to the combativeness which is inseparable from strong convictions.

The historical portions of the First Edition, in which the earlier achievements of Fortification were summarized, are retained as being essential to a broad view of the subject; but nearly one-half of the volume has been either rearranged or rewritten. New chapters dealing with the general policy of Land Fortification, and with the defence of Port Arthur, have been added. The evolution of warships has been entirely recast, and an attempt is made to represent it in pedigree form. As foreign armoured ships do not differ materially from our own from the point of view of coast defence, the history of their development is omitted.

Thus, the general character of the work remains unchanged. It is not in any sense a text-book of Fortification; but I venture to think that it embodies principles and historic facts which are the necessary foundation of the text-book. My hope has been, by avoiding the technicalities of military engineering as far as possible, to interest soldiers generally and the many civilians who now desire to understand questions of national defence.

Our circumstances differ in important respects from those of most other Powers, and our problems are specially complex. The factors which determine the defensive strength of the British Empire are many and various. To hold a just balance, having regard to geographical conditions, to distance and time, to resources general and local, to natural aptitudes or disabilities, and to national finance, is exceedingly difficult. The only sure guidance must be sought in the experience of war. Long and earnest study has led me to the views which I have ventured to express in this book. If it serves only to suggest lines of independent

thought and of historical research to other minds, my object will be attained.

My best thanks are due to Captain W. C. M. Nicholson, R.N., and Captain J. R. Chancellor, D.S.O., R.E., for much kind assistance.

G. S. CLARKE.

LONDON, *March*, 1907.

PREFACE TO FIRST EDITION

THE number of works on Fortification in the English language is small. The sumptuous volumes which annually appear in Paris and Brussels have no counterpart here. The keen discussion which the subject excites in France and Germany wakes but a faint echo on this side of the Channel, and an explanation of this marked difference can easily be suggested. Land defence in the British Empire is, perhaps, not seriously regarded, notwithstanding that we have expended large sums upon it. The North-West Frontier is far distant, and its protection may possibly be looked upon as a matter for the Government of India, not for us at home. Coast defence must apparently claim consideration, if only for the purpose of correctly adjusting its scale to the real needs of the Empire; but such questions are probably assumed to be exhaustively discussed by experts with whom the uninitiated may not intermeddle. It results that there is no school of thought in regard to Fortification; that elementary principles are still floating in solution; and that no approach to a consensus of matured opinion is ever attained.

Of mere text-books there are enough; but these works are apt to be swamped in the dreary morass of technicality. Principles are lost in details, and criticism can have no place where dogma must necessarily reign supreme. Again,

text-books tend to repeat each other with remarkable fidelity; and views, possibly fallacious, receive acceptance after sufficient reiteration. Finally, the text-book cannot well suggest the existence of doubt, may not refer too pointedly to current controversies, and must assume a large measure of certitude.

At the present moment, views of all kinds in relation to questions of Fortification are being widely proclaimed abroad; the old faiths have been rudely shaken; certitude can no longer be assumed. There is a school which asserts that the elaborate works in which France has sunk vast sums are indefensible, simply because shells carrying a high explosive can now be fired with tolerable safety to the besieger. There is another school which holds, as strongly, that the tendency has been to exaggerate grossly the real requirements of Fortification, and that France on her North-Eastern frontier, and Belgium on the Meuse and at Antwerp, have squandered money in complying with the demands of the merest theory. Amidst so much doubt, and in presence of opinions so conflicting, the views here advanced need no apology.

For the British Empire, land defence has only a subordinate importance. Our national existence depends upon "Sea Power," and will end for ever if that Power is once definitely lost. Had the problem of national defence been fully grasped, the costly works at Portsmouth and Plymouth would have assumed a very different form. By the sea our forefathers won Empire; by the sea alone can their descendants lose it. The British Empire demands a certain measure of naval strength as the first condition of security and permanence, and no defences on shore affect the question of this necessary naval strength in the smallest degree. The requisite standard of naval strength having been fixed, the questions arise as to what remains for Fortification to

accomplish, and what kind of Fortification is best suited for the purpose.

The objects which the writer has kept in view may be briefly summed. It has been sought, in the first place, to arrive at a just estimate of the war achievements of Fortification. Beginning with the sieges of Marlborough and Eugene, the history of Fortification in the Peninsula, the Crimea, the Russo-Turkish campaigns of 1828-29 and 1877-78, the Danish War, the American War of Secession, and the Franco-German War, are sketched in broad outline, and the general results criticised and compared. The evolution of the defence is traced down to the present day, and the many and various recent proposals are discussed in the light of such experience as is available. The principles which it is maintained should guide future progress, in view of the latest developments of arms, are then defined.

In the large portion of the work which deals with coast defence, prominence is given to the great practical experiment carried out at Alexandria in 1882. No secure basis on which to rest coast defence can be found without a careful study of the capabilities and disabilities of the modern ship of war. The evolution of armoured navies is, therefore, sketched, and a selection of types of British and foreign vessels is given. Appendices are added, in which the principal details of the armoured ships of France and Russia are tabulated.

The higher criticism should always be constructive, and it may seem that the present work deals too largely in destruction. This is, however, practically inevitable. Cut-and-dried systems of Fortification have no longer any place in military science. Judged by the test of war, t is doubtful whether these systems ever possessed any special value; while it is certain that the homage blindly accorded to them has cramped the views of many generations of engineers

and induced a certain disregard of real military requirements. Geometry has its proper sphere ; but when it is permitted to dominate Fortification, military science and military progress necessarily suffer. In place of the rigid formulas which so greatly simplify the work of the instructor, all that can now be given are broad general principles. We must study carefully the results obtained in war, and correctly analyze their causes. We must as carefully follow the development of modern arms, and from the data afforded by peace experiments seek to draw sound inferences. Thus only can the progress of Fortification be wisely ordered.

A considerable portion of the following pages has already appeared in four papers published by the Royal Artillery Institution. These papers, revised, expanded, and partly rewritten, are now republished with the permission of the Committee, in the hope of aiding the solution of some difficulties, of clearing away some of the cobwebs in which Fortification lies half-smothered, and of attracting a larger class of thinkers to a subject which has no real mysteries. The intelligence with which military questions are publicly discussed has markedly increased of late years, and the more that intelligence can be developed, the less will be the risks of those mistakes of policy for which a nation pays dearly.

G. S. CLARKE.

LONDON, *July*, 1890.

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FORTIFICATION

CHAPTER I

INTRODUCTORY

No science is so delightfully empirical as that of Fortification. The test of experiment cannot satisfactorily be applied to it; that of practical experience is generally ambiguous. No fad is so unimportant that an instance cannot be found which affects to illustrate its utility; no theory so unpractical that evidence of some sort cannot be produced for its support. For the data are never scientifically complete, and each successful or unsuccessful attack or defence may generally be traced to any one of a dozen causes in accordance with the personal predilections of the writer.

Thus, on the assault of Tel-el-Kebir may evidently be founded a specious argument in favour of night attacks on fortified positions unprepared by Artillery fire. The necessity for a careful preparation by a competent siege train may be regarded as the principal lesson from Plevna. Fort Kanly at Kars has been found to indicate the efficacy of an interior "keep." Toul may go to show either that it is desirable to keep trees standing on the glacis, or that it is essential that they should be cut down; Sedan, that old-type continuous *enceintes* are worse than useless; Strasburg

that they are by no means to be despised; Donelson, that extemporized earthworks are incapable of resistance; Sebastopol, Vicksburg, Petersburg and Wagner, that they are remarkably efficient. Going still further back, Badajos in 1812 may be assumed to preach the practicability of escalade, and in 1811 its probable hopelessness. Salamanca supplies a strong argument in favour of the employment of watch-dogs[1] at night; and this catalogue of instances might be indefinitely extended without difficulty.

The results of peace experiments lend themselves almost more readily to the exigencies of anyone possessed by an *idée fixe*. We can take them literally and enlarge upon the extraordinary destructiveness of modern weapons; or we may minimize them, applying any corrective factor for service conditions which appears best to suit our individual views. An historical fact may even be suppressed or altered by a partisan writer to fit his thesis[2]—a method of procedure which, however, is not unknown in connection with other non-exact sciences.

Such conditions tend inevitably to the enunciation of opinions as divergent as they are positive; but they nevertheless lend a certain speculative charm to the subject. Fortification is even as the field of metaphysics, where we can roam at will, accepting with contentment the teaching of any one of half a dozen eminently respectable coteries of schoolmen, or seeking the more exciting pleasures of the free lance. The science sadly suffers, however, from the general instability of its data, which tends to make progress

[1] Watch-dogs were used by Belisarius in the defence of Rome against the Goths, A.D. 537.

[2] Thus a writer in the *Independence Belge*, being sorely in need of an illustration of the efficacy of ditch-flanking arrangements, quoted the repulse of the German attack on the Perches redoubts at Belfort as a case in point. The ditches of these provisional works had no flanking arrangements of any kind.

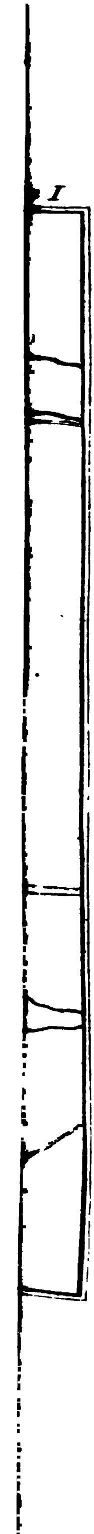
slow and often ill-ordered ; while, in England, where there are few or no opportunities for full discussion, that rough average of the opinions of many minds which presumably approximates to wisdom is never formulated.

In the following pages an attempt is made to analyse briefly the results obtained by land Fortification in the past, and to forecast the changes in practice which appear to be justified by the altered conditions of war. The task has been undertaken with a full realization of the difficulties as well as the temptations above pointed out, and the conclusions arrived at deserve to be accepted only in so far as the reasoning on which they are based is able to carry conviction.

Whether the national advantages to be gained from permanent Fortification are greater or less now than formerly, Europe has been fortified to an extent and at a cost undreamed of in the pre-rifling period. The defences of Paris at the present time are on a scale altogether unprecedented. Never were the frontier fortresses of France and Germany in such a high state of technical efficiency and internal organization as now. Austria has devoted large sums to the defences of her eastern boundary. Great fortified places of arms have been constructed at Liége and Namur, and further expenditure is contemplated at Antwerp. Roumania has converted Bucharest into a huge entrenched camp. Italy has largely developed her coast defences. The defences of the coaling stations of the British empire have been completed ; the fortresses at home and abroad have been revised ; the principal home commercial ports have received armaments. In this country, however, an era of moderation in regard to permanent Fortification appears to be dawning and the reduction of superfluous guns is contemplated, while the ill-conceived defences of London are to be abandoned.

The science of Fortification—in the broad sense—has probably justified the great expectations which appear to have been formed of its capabilities. The successes obtained of late years by the defence, *quâ* defence, have certainly been far more conspicuous than those won by the attack. Kars perhaps excepted, there is no modern instance of failure where the conditions—from the point of view of Fortification—were moderately favourable. There have been few cases that can well be regarded as striking technical successes—triumphs over Fortification on the part of the attack—since the Peninsular War; and Wellington's successful sieges were remarkable chiefly on account of the miserable appliances with which it was necessary to conduct them, and the great personal gallantry sometimes displayed. The inherent tactical and strategic drawbacks of the defence, about which it is perfectly easy to discourse, German-fashion, at any length, have nothing to do with the present purpose. It might have been wiser for the Russians to have abandoned Sebastopol after the battle of the Alma, and to have withdrawn from Port Arthur, or for the Turks never to have cut a shelter-trench at Plevna; but viewed simply from the Fortification standpoint, the defences of Sebastopol and of Plevna were brilliantly successful, while that of Port Arthur, though not protracted to the extreme limit, entailed upon the Japanese immense losses and the preoccupation of forces elsewhere needed. Similarly, the siege of Paris, though ending in national disaster for France, can only be regarded as a triumph won by indifferent and superannuated defences.

Permanent Fortification occasionally produced good defensive results, before the establishment of the French school, which was destined to exert a powerful influence extending to a recent period. Long and costly sieges were not unknown. Ostend held out from 1501 to 1504, thus rivalling the memorable defence of Gibraltar. Rochelle in 1572 with-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stood eight assaults, and is stated to have cost the besiegers 20,000 men. Yet, notwithstanding that the conduct of a siege in those days was chaotic, a writer in 1628 thus slightingly summarizes the performance of the fortresses of his time : " The strongest do not hold out more than six weeks ; the best cannot take care of themselves without an army close at hand."[1] This is a significant testimony to the general inadequacy of permanent Fortification, even at a period before order and science had been brought to bear upon the attack.

The 17th century produced Vauban and his school, in whose hands permanent Fortification grew to be treated somewhat as a geometrical puzzle—a species of maze designed on the principles which may have guided the chief engineer of Henry II. in laying out the approaches to Rosamond's bower, and, on the whole, little more successful in keeping out the invader. The surviving examples of this school are dwindling. The land front of Valetta remains, however, as an interesting historical monument ; but, in spite of some undoubted elegance of treatment, does not by any means serve to give a complete idea of the refinements of line and angle attainable under favourable conditions.

The fortress of Lille (Plate I.) is a good example of the defences which sprang up round a large number of the towns of Western Europe, under the auspices or the influence of Vauban. Vast sums were thus entombed, but it is certainly open to question whether the results obtained were proportionate. Of Vauban himself, Marmont writes : " He was more of an engineer than a general, and in making great numbers of fortresses he followed the bent of his own predilections." The criticism is not altogether unjust. Vauban's conception of the use of Fortification in relation

[1] Pagan.

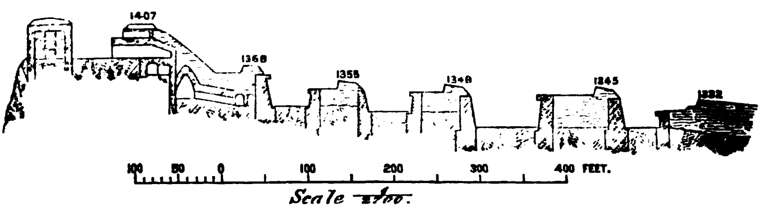
to strategy was by no means justified by its results ; while to the science in its narrower aspect, he contributed little that was of real value. By the irony of fate, however, Vauban came to be regarded as the creative genius of the defence, and the great work of his life—the work by which he well merited lasting fame—was half forgotten. The average human mind is naturally impressed more deeply by concrete facts than by abstract ideas, and the great engineer who was the first to reduce the attack to a well-organized system, and himself to demonstrate its success in a long series of sieges, was almost lost in the man who covered France with fortresses, of which about half were unnecessary, if not undesirable.[1] The result of this mistaken identity unquestionably cramped the whole science of Fortification, and the narrowing influence is only now disappearing. Until recent years the various Vauban systems were regarded and taught as the basis of permanent Fortification, which they are not in any sense. Fortification and tactics have but one and the same basis in all ages, and that is the *power*, in the widest possible sense, of the weapons of the attack and defence. The only scientific Fortification is that which enables the defender to use his weapons to the best advantage, while minimizing the potency of the weapons of the attacker.

The geometrical foundation of the Vauban systems was the bastioned trace. Draw a polygon round the area to be defended, make of each side a bastioned front, obtain saliency and a cross fire over the front by ravelins. This was the foundation to which Vauban, in his so-called first system, added little. Supplement this trace by any number of counterguards ; place an independent reduit—in England to be erroneously termed a "redoubt"—in every

[1] As pointed out by Jomini, France had no less than 40 fortresses on one-third only of her frontier.

available angle ; build high cavaliers to give simultaneous lines of fire ; retrench everything retrenchable ; throw out hornworks, crownworks, tenaillons, demi-tenaillons, etc., to the front, thus indefinitely increasing geometrical possibilities ; finally, build a "citadel" in which most of the above artifices could be repeated inside the main line, and one arrives at a fair idea of what may be termed the linear method of Fortification. The section through the citadel of Belfort on the front selected by the Germans for attack, serves to illustrate forcibly the practical outcome of linear principles. When these works were constructed,

CITADEL OF BELFORT.



Keep. Cavalier. Flank Casemates. 1st Envelope. 2nd Envelope. Ravelin. Covered way in Crownwork.

it must have been confidently expected that each of the several lines of defence would be able to hold out after those in front were lost, and that the general causes which had brought about the capture of one would not suffice to secure that of the whole.

When analysed, the ruling motive of the traces of the 17th and 18th centuries appears to be the effort (1st) to obtain flank defence in any degree of imaginable complexity, and (2nd) to provide for a step by step resistance after the crowning of the covered way, with the idea of entailing upon the attack a series of successive breaching operations, ending only with the fall of the citadel, involving a fresh siege.

Cormontaingne and Foucroy, with singular boldness, drew up a species of time-table of the theoretical duration of the defence in various cases: Vauban's 1st system, 19 days; 3rd system, 26 days; Cormontaingne's system, 32 days; Coehorn's, 21 days, etc., etc. Sorties, mines, counter-approaches, and extemporized entrenchments—everything, in fact, which did not come within the cognizance of the drawing office—were ignored by these ingenious theorists.

As Sir J. Jones has pointed out, however, "the powers of defence of any particular trace are scarcely susceptible of nice analysation,"[1] and there is no reason to suppose that any real advance in defensive strength was ever attained by complication.

[1] "Journals of the Sieges in Spain."

CHAPTER II

SIEGES OF MARLBOROUGH AND EUGENE—SIEGES OF THE PENINSULA—LINES OF TORRES VEDRAS

THE sieges of the Wars of Marlborough and Eugene in the early part of the 18th century,[1] may be taken as giving a fair index of the resisting power of fortresses at a period following lavish expenditure on permanent Fortification, and when Vauban's method of formal attack was in full operation. Never before or since have the attack and defence met on more equal terms, and these sieges may almost be regarded as crucial tests of the defensive efficacy of the Fortification of the time.

It is freely admitted that in comparing individual sieges, the standard of duration cannot be adopted as a measure of the resisting power of respective systems of Fortification. No such comparison is ever really possible, or trustworthy, on account of the variety of the conditions and the impossibility of arriving at a least common denominator. If, however, the average of a number of sieges, at a somewhat special epoch in the evolution of Fortification, is taken into consideration, a fair general idea of the value of the systems of the period may surely be arrived at. Here and there doubtless arises an exceptional case. Ulm, in 1706,

[1] All the principal sieges of this period are summarized in Appendix A, the information being derived from "The Military History of Prince Eugene and the Duke of Marlborough." Claude du Bosc. 1736.

for example, surprised by a party of "officers" of whom "the youngest and handsomest were dressed in the habit of women," clearly offers no teaching on vexed questions of trace. And, similarly, the fall of Brisac, possessing probably one of the most elaborate systems of defence[1] ever carried into execution, and taken without assault in fourteen days, may evidently be explicable on grounds with which Fortification has nothing to do.

It must nevertheless be admitted, that considered in their broad aspects, the sieges of the Wars of Marlborough and Eugene give a fair measure of the capabilities of permanent Fortification, in what may be deemed its palmy days. If the French revival, inspired by Vauban, had produced any marked effect; if the elaboration of trace had proved a pronounced advantage, these sieges must apparently have afforded clear indication of the fact. They do nothing of the kind.

Excluding from the list in Appendix A the cases of Turin and Toulon,[2] which were not taken, the average duration of the twenty-nine remaining sieges is under thirty-four days—a period actually less than that of the resistance offered, in some cases, by almost identical fortifications to the German Artillery in 1870-71.

Notwithstanding that, in the Fortification of this period, special attempts were made, by elaborate measures of

[1] Designed by Vauban, who himself directed the attack.

[2] Toulon, attacked both by land and sea, made a successful defence of sixty-four days, the siege being then raised. But Toulon was an indifferent fortress at the time, and had apparently to depend to a great extent on field works hastily thrown up. Turin made an altogether exceptional defence of 136 days, before it was relieved; but this resistance must be ascribed rather to careful preparation, to the works created by the Duke of Savoy in anticipation as well in the course of the siege, and to the fact that the communications remained open till a late period, than to permanent Fortification. Turin was, in fact, an 18th-century Sebastopol.

interior defence, to allow of breaches being defended, it appears to have been generally admitted that to offer resistance to an assault was a hopeless task involving unjustifiable slaughter. In one case only[1] out of twenty-nine sieges does an assault appear to have been awaited, and Marshal Boufflers in 1708 surrendered Lille, the strongest fortress in France, with the full consent of the King, rather than risk assault. The siege of Lille (Plate I.) is remarkable, however, for the fact that its citadel—unlike citadels in general—held out after the fall of the town.

Regarding the sieges above referred to in the light of such details as are available, it seems clear that in the majority of cases the refinements of detail and trace, to which theory has delighted to assign disproportionate importance, exercised no influence whatever over the issue. In the remaining instances, there is nothing to lead to the conclusion that these refinements produced any real effect, and not one of the twenty-nine sieges enumerated rivalled that of Haarlem in the previous century, defended by works constructed mainly after the arrival of the besieging force. It is worth noting that some of the most protracted defences—Landau (1704), Turin, Toulon—were made by fortresses whose permanent works had been largely supplemented at the last moment.

Broad military principles—not the technical artifices which were dear to Uncle Toby and Major Dugald Dalgetty—appear to have determined the issue in the sieges of this period. Then, as now and always, events declined to take the course prescribed for them.

The Peninsular War furnishes another distinctive group of sieges, of which an admirably lucid account has been left us by Sir J. Jones.[2] The précis of these sieges given in

[1] Liége, 1702.

[2] "Journals of the Sieges in Spain." Of this almost unique work, "no second edition was allowed to appear" till about 1826; because "the

Appendix B shows that, out of nine cases, the attack failed in two—Badajos in 1811, and Burgos. Excluding Olivença, left almost without a garrison, Fort Napoleon at Almaraz, which was not actually besieged, Salamanca, which cannot be regarded as a fortress, and the Retiro at Madrid, which practically offered no defence, the average duration of the three remaining successful sieges was thirty-one days. Including the first siege of Badajos and that of Burgos, the average duration of the defence of the five fortresses actually besieged was about thirty-three days. On the one hand, the Spanish fortresses were weak and in poor repair, and on the other hand, the resources of the attacking force were generally inadequate.

The sieges in the Peninsula deserve special notice, however, if only on account of the numerous instances of assault and escalade which they present. It is not unusual to point to these sieges as evidence of the practicability of assault and escalade; but little reference is generally made to the failures.

Statements of the assaults of breaches and of the escalading operations of the Peninsular sieges are given in Appendices C and D. Of twelve assaults, five were successful, including that of the great breach at Ciudad Rodrigo, which would have failed but for the success gained at the little breach.[1] Of all the breaches independently stormed,

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attention of those entrusted with regulating the engineers' branch of the army being at the time zealously engaged in giving it due organization and efficiency, any further discussion would have been misplaced." In other words, at a period when the remedying of gross evils was being taken in hand, the publication of the cool observation of the effects of those evils by a practical soldier was deemed inopportune. Meanwhile General Foy was sneering at the poverty of our military literature: *Jusqu'à ces dernières années pas un auteur national n'avait écrit* ex professo *sur les parties savantes de la guerre.*

[1] At the siege of Tarifa by the French in 1810, a good breach was made; but the assaulting columns were broken up and dispersed by musketry fire before reaching it.

that of St. Sebastian only was retrenched. The opinion of Sir J. Jones, that if a breach is well retrenched and provided with obstacles "no conceivable superiority of courage can counterbalance such advantages" appears to be amply justified. Again, of twelve attempts to escalade, six were successful; but of these one, St. Roque Lunette at Badajos, was practically unopposed, and three—Picurina Lunette at Badajos, Fort Napoleon at Almaraz, Fort St. Michael at Burgos—were not serious affairs either as regards the obstacle to be surmounted or the resistance offered. There remain two brilliant examples—the Castle and St. Vicente Bastion at Badajos—as to which Sir J. Jones remarks, "the efforts of British troops occasionally set all calculations at defiance, and when a few years shall have swept away the eye-witnesses of their achievements of this night, they will not be credited." Those eye-witnesses have all passed away, and the devoted gallantry displayed in the second siege of Badajos can hardly be too often recalled; but such highly exceptional successes no more serve to point a moral, in relation to the permanent Fortification of to-day, than do the exploits of Horatius and his two companions in relation to the tactics of the defence of bridges.

While assault of the breach and escalade were almost unknown in the earlier sieges, every fortress included in Appendix B was either assaulted or escaladed, or both. The systematic occupation of a breach in accordance with the method laid down by Vauban was regarded as an operation so certain as to justify capitulation in advance. Napoleon has even been blamed for the barbarity implied in his orders to the Governor of Antwerp, in 1809: "*Enfin nous attendons et voulons qu'il courre les hazards d'un assaut pour prolonger la défense et augmenter la perte de l'ennemi.*"

If, however, retrenchments, permanent or extemporized, have any *raison d'être* at all, it must be sought in a prolonged

defence after the main line has fallen, whether by escalade or assault of the breach. In the Peninsular sieges, the approaches were so imperfect that the excuse for premature capitulation did not exist, and at the same time urgency dictated assaults. Hence arose one of the chief characteristics of these sieges. The result proved that, in such circumstances, breaches were eminently defensible, only one retrenched breach (St. Sebastian) being successfully stormed, and the issue in this case being determined by the powerful effects of the Artillery fire directed against an adjacent portion of the works by which a great mass of combustibles within the lines was ignited.

Although the siege train at the disposal of the Duke of Wellington was always inadequate, the available Artillery was far more powerful than that employed in the earlier sieges. Gunpowder had fully doubled in strength, and iron guns had been so much improved as to be greatly superior to those of brass. The results obtained were far beyond anything previously recorded. It was found that an exposed wall could be breached with certainty up to a range of 700 yards. To attempt to breach such a wall even at 1,000 yards appeared to be justifiable. Accurate enfilading fire could be carried on up to at least 1,500 yards. Smooth-bore siege Artillery had in fact nearly reached the zenith of its power.

The fortresses besieged in the Peninsula were in most respects indifferent, and Badajos, the best of them, had apparently not been revised or restored for more than fifty years; although in the nine months' interval between the first and second sieges, the French considerably improved the defences. Burgos, "a very insignificant fortress," was little more than a mediæval castle in a position naturally strong. At the points breached and assaulted, Ciudad Rodrigo presented a revetment exposed nearly to the foot,

an unflanked ditch, and a low *fausse braie ;* St. Sebastian offered only a town wall, bare to the foot and supporting a single narrow rampart.

Permanent Fortification could not be expected, therefore, to show to advantage in the Peninsular War. Nevertheless, partly on account of the indifferent resources of the besiegers, and partly by reason of the vigorous defence made by the French, the sieges equalled those of the previous century in average duration. As regards Fortification, the principal lessons of the Peninsular sieges seem to be the ease with which a large breach could be formed in an exposed revetment, and the success with which such a breach could be defended by temporary expedients.

If ever there was an opening which appeared to lend itself to assault, it was the great breach at Ciudad Rodrigo, thoroughly accessible for 100 feet in breadth, formed at the angle made by an unflanked ditch, not permanently retrenched, and with a rampart so narrow as to preclude an efficient improvised retrenchment. Accident even favoured the storming party in the premature ignition of the mass of combustibles placed by the defenders at the foot of the breach. Yet it seems clear that the issue was only decided by the success obtained at the little breach, which was "not obstinately disputed," nor retrenched in any way.

Even when allowance is made for the poverty of the resources of the besiegers, it must be admitted that, judged by the standard of the 18th century, the indifferent fortresses of the Peninsula acquitted themselves creditably. Further, it appeared that their chief weakness was not the want of elaboration of trace and minor artifice ; but simply the hopeless exposure of revetments and the general inefficiency of the Artillery defence. Given revetments moderately covered, together with a more numerous and better provided Artillery, these sieges would have been materially

prolonged. By selecting a suitable incident here and there, deductions can doubtless be made, which, by a strained generalization, may be rendered applicable to any conditions in any age. One writer, for example, discovered that the siege of Guisnes in 1558, " brings out very strikingly the value of hidden flanks." The siege of Jericho would probably afford interesting data as to the stability of revetments, if we were in possession of fuller historical details of the operation.

Permanent Fortification obtained one curious success in the Peninsula, but of an essentially negative character. Campo-Major, a fortress requiring a garrison of 5,000 men, " was held against the French by 200 militia and five guns, under Major Tallaia, of the Portuguese Engineers." The permanent defences enabled the real strength of the defenders to be concealed, and the French were actually " induced to sit down regularly before the place with 5,000 men, bring up a battering train, and open trenches." A breach was regularly formed, entailing the loss of much valuable time, and Major Tallaia, who must have possessed some of the talent of the actor, only marched out two days before the arrival of Sir W. Beresford. This striking instance of passive resisting power should always be remembered to the credit of permanent Fortification.

The rôle played by the Peninsular fortresses was completely eclipsed by that of the provisional defences of Torres Vedras. At the present day, to hold a line of good earth redoubts covering a sea base, would be considered a comparatively obvious and simple operation in the case of a Power possessing the command of the sea. If Plevna had been in free and inviolable communication with Constantinople, the Russians might have been in front of it for years. When, however, the Peninsular War broke out, it was almost an axiom that " an army receiving battle in position must be beaten," and

this, like many another axiom equally fallacious, appeared to be capable of historical support.

In setting aside such formulas, the Duke of Wellington showed genius of the highest order, and there is nothing in all his career which evinces more independence and originality of military judgment than the conception of the lines of Torres Vedras. If the idea violated some cherished principles, so also did the works. A line twenty-nine miles long was held by a force providing only about 1,600 men per mile. Flank defence of ditches, attempted in a few of the earlier redoubts, was given up altogether, the traces being based on the ground alone.[1] The redoubts did not flank each other, and were in many cases more than a mile apart. Yet Massena did not even attempt to attack the position, and there can be no doubt that he was right. Fortification, in the case of the lines of Torres Vedras being exactly adjusted to the strategic and tactical requirements, perfectly fulfilled its objects.

[1] A proposal was made twenty years ago to build redoubts "on a bastioned trace" as a defence against Indians armed mainly with bows and arrows.

CHAPTER III

WARS OF NAPOLEON—DANZIG—SARAGOSSA—TARRAGONA — MAINZ — ANTWERP — VAUBAN — MONTALEMBERT — CARNOT — FORTIFICATION BETWEEN THE BATTLE OF WATERLOO AND THE SIEGE OF SEBASTOPOL—LINZ

Except in Spain, the wars of Napoleon were not fruitful in sieges, thus contrasting strongly with those of the Marlborough era, in which the reduction of fortified places assumed a principal rôle. Napoleon, availing himself to the full of the improved road communications of Europe, sought and obtained success by rapid movements, which procured the fall of the fortresses without tedious siege operations. Thus, in 1800, the battle of Marengo gave to the French most of the Austrian fortresses in Italy. Conversely, in 1813, the French garrisons left in the fortresses of the Elbe and the Oder surrendered on the advance of the Allies to the Rhine.[1] The fortresses at this period appear to have been usually in the wrong place. "France had too many, Germany had too few."[2]

The two sieges of Danzig perhaps deserve special notice. The fortifications consisted of a bastioned *enceinte* of simple form. The first siege, in 1807, lasted seventy-six days, and

[1] "Je me bornerai à dire que Napoléon laissa dans les forteresses d'Allemagne 80,000 soldats, dont *pas un seul* ne revit la France avant la chute de l'Empire, qu'ils eussent peut-être prévenue si on les avait rémis sur nos frontières!"—Mémoirs du Général de Marbot.

[2] "The Operations of War."—Hamley.

was remarkable for the vigour with which the defence was conducted, the length of time during which the besieged were able to hold the field works thrown up in advance of the permanent lines, and the support afforded by the Artillery fire of the fortress.

Besieged again in 1813, Danzig made a defence of more than forty days, preceded by a six weeks' blockade. In neither case can it be said that technical refinements played any determining part, although an attempt has been made to utilize the incident of a blockhouse in the covered way, which was tenaciously held by the defenders in the first siege, for the exaltation of keeps and reduits in general.

The French sieges of Saragossa afford a striking proof of the small influence of Fortification as compared with that of the spirit with which a defence is conducted. Saragossa, which might "almost be called an open town," was enclosed by an "old brick wall ten feet high and three feet thick."[1] The investment was completed on the 27th June, 1808, and the breaches were assaulted on the 2nd July. The attack was repulsed with great loss. On the 31st July, the town and the breaches were again bombarded. The latter were attacked and carried on the 4th August; but the Spaniards maintained a house-to-house resistance till the 14th, when the French retired. Thus, this mere walled town withstood "a siege of forty days by 17,000 troops of the most experienced and successful army in Europe," who were triumphantly repulsed. Saragossa was again invested by 38,000 French troops on 19th October, 1809; fresh breaches were made and carried by assault, the attack then proceeding by sap and mine from house to house. The town at last fell, after a heroic resistance of fifty-two days. On the experience of these two sieges it has been sought to found an argument for "masonry keeps."

1 "Annals of the Wars of the 19th Century."—Cust.

Tarragona, in 1811, resisted the French for forty-seven days. On the 3rd June, 1813, a mixed British and Spanish force 14,000 strong, with a siege train of fifty guns, was disembarked before it. The French garrison was inadequate, and two of the outlying forts were taken immediately. The breach in Fort Royal was reported practicable on the 9th; but the assault twice ordered was twice countermanded, and the siege guns were spiked and abandoned on the 12th, in consequence of the rumoured advance of a relieving force which was at that very moment moving in the opposite direction. The allied force then re-embarked, and the operations, which appear to have been thoroughly mismanaged, ended discreditably.[1]

Reviewing the sieges above noticed as a whole, it is impossible to draw from them any definite deductions which serve to support the theorizing of some text-books. An incident picked out here and there may doubtless be utilized in favour of any caprice of the drawing-board, simply because the exact circumstances of the case—all-important in determining scientific judgments—cannot now be ascertained.

Certain broad principles, however, stand out clearly enough. Revetments which could be easily breached, even at a distance, bringing down with them masses of parapet, proved unsuitable for purposes of Fortification. Long untraversed faces exposed to enfilade fire received practical condemnation. The necessity for good and sufficient bombproof cover for troops in close proximity to their fighting stations was universally manifested. A general deficiency in Artillery power and a certain helplessness in handling guns characterized the defence in most instances; vertical

[1] "The best of the story was that all parties ran away. Maurice Mathieu ran away, Sir J. Murray ran away, and so did Suchet." — *Wellington Despatches.*

fire in particular was far too little employed. While, thanks to Vauban, the tactical handling of the attack had been reduced from chaos to order, that of the defence was frequently faulty. For the rest, the acute remark of Sir J. Jones, above quoted (p. 8), was abundantly justified, and the worthless speculations of Cormontaingne and Foucroy (p. 8) were completely falsified. The beauties of trace and petty artifice melted away in the rough crucible of war. Defences were short or long, contemptible or brilliant, in accordance with the spirit of the troops, the genius and readiness of resource of their commanders, the available supply of food and ammunition, and not because the fortress was laid out on simple or complex lines.[1] Within broad limits, the nature of the fortifications mattered exceedingly little; general tactical conditions decided the event.

The lines of Mainz, in 1795, "composed of works of rare perfection—the most considerable of the kind that have been executed in modern times"[2]—and held by 30,000 French troops, fell to the attack of two weak detachments, which "sufficed to create a disorder that nothing could remedy." And later, in 1832, Antwerp, a model stronghold of its day, possessing the advantage of an Artillery of unusual strength relative to that of the attack, made a defence of only twenty-five days, thus falling short of the performance of obsolete Longwy, in face of the German siege guns in 1870-71.

The dominant influence of Vauban, which directly ruled the science of permanent Fortification during part of the 17th and 18th centuries, extended far into the 19th, and

[1] "*En général, ni les fortifications, ni le nombre des soldats qui defendent une ville*" matter greatly. "*Tout dépend de la tête plus ou moins forte de celui qui y commande.*"—Frederick the Great.

[2] Marmont.

still lingers. For a long period of years, France practically dictated military science to Europe, and when in process of time she had ceased to exercise this function, the fact was slowly grasped, especially in relation to Fortification. Meanwhile, however, other masters had arisen, whose schemes, finding small favour in France, received little contemporary recognition, and can scarcely be said to have been practically applied till after the fall of Napoleon. Montalembert—a far more original genius than Vauban—had criticised the French school as early as 1776. "The inherent vices of the bastioned systems have been pointed out; we have proved from authentic facts that the flanks in this method of fortifying were of no effect."[1] Yet Montalembert did not live to see the realization of his principles in the so-called German or polygonal system, and has never received the recognition he well deserved.

Following Montalembert, Carnot also evinced originality and independence of judgment. The detached wall associated with his name shows a clear grasp of a principle far more important than the trivialities of trace and detail which have sometimes been mistaken for progress. In insisting on a strong development of vertical fire as a powerful adjunct to the defence, Carnot also showed sound military prescience. The value of such fire is now beginning to be recognised. It was easy to overthrow the figures which Carnot imprudently adopted, and to show that his calculated distribution of balls was eminently fallacious. A mathematician of his calibre was quite able to anticipate the facile criticisms which were directed against "*La défense des places fortes*," and in committing himself to these unfortunate figures, Carnot merely adopted an obviously *ad captandum* style of argument, which rarely secures more than momentary success. The fact remains,

[1] *La fortification perpendiculaire.*

that he was one of the first to claim an all-important place for high-angle fire on the part of the defence, which will become a military commonplace.

Between the battle of Waterloo and the siege of Sebastopol, which practically marks the close of the smooth-bore era, much fortress-building took place, in Germany especially. Posen, begun after 1828, embodied "the latest developments of the Prussian system of fortification up to the commencement of the rifled arm period."[1] Detached forts were first built on the most important positions, and then connected together by an *enceinte*. The Carnot wall was generally adopted, and caponiers and counterscarp galleries usurped the ditch-flanking functions of the bastions. Fortification ever tends to exaggeration, and at Posen the caponier assumed colossal proportions, becoming, in fact, a many-tiered citadel, prolonged through the rampart of the *enceinte* so as to flank it in rear, filled with dwelling casemates, and containing an interior court large enough to serve the purpose of a parade ground. The ravelin survived entire, and the rampart in rear of it retained rudimentary flanks.[2] Bomb-proof casemates were provided in the salient and re-entering angles of the covered way, and in the salients of the ravelins.

Other fortresses followed the general principles of Posen, but showed moderation in the matter of caponiers. The detached wall marked a distinct step in advance; and, as regards trace, the so-called German system was superior to that of Vauban's later designs, by being simpler, admitting fewer caprices of the compass and ruler, and costing less. Comparing this system, however, with that termed "Modern

[1] Colonel (the late General Sir) H. A. Smyth, R.A., "Proceedings," R.A. Institution.

[2] These rudimentary flanks, as useful as the mammary glands in the male animal, possess a curious interest for students of the evolution of Fortification.

French "[1] by the professors, the balance of advantage of trace cannot be adjudged. By laying down in advance the precise line of action in the attack and defence it becomes perfectly easy to write an essay clearly proving that one is distinctly better than the other; but the most cursory study of the history of war serves to show the uselessness of such speculations.

The resurrection on a large scale of the principles of ditch flanking by caponiers, or galleries, marks an historic epoch in the evolution of permanent Fortification, rather than a definite step in advance. It is remarkable that this principle, adopted in early Italian designs, and effectually suppressed for long years on purely theoretical grounds, should ultimately have reasserted itself. Judged by the test of war, however, ditch-flanking arrangements have extremely little importance compared with other matters freely neglected.

The exaggeration of the caponiers at Posen and elsewhere is readily explained. It was anticipated that the besieger would make his batteries on the crest of the glacis at the salient of the main ditch, and the many-tiered caponier was intended to overpower them. We can never now know how the battery and the caponier would have fared in a duel *à outrance*; but it seems clear that as soon as the covered way was crowned, the construction of a gallery of descent would offer far fewer difficulties than that of the battery, and would be a much more natural course of procedure. The counterscarp having been blown in, the caponier would offer no great obstacle to sapping across the ditch. In any case, the approved form of attack on a polygonal front led through the ravelin, and would not have concerned itself with the faces of the caponier.

[1] The system thus unhappily styled and utilized for the mystification of successive generations of cadets was evolved from the inner consciousness of the professorial mind, and has never been applied anywhere.

No regular siege has yet been carried out against a fortress built on the "German" or "polygonal" system. The chains of forts which have been added to all fortresses of modern importance practically preclude the chance of an attack on such an *enceinte*. We shall never, therefore, be able to make any comparison, however rough, between the French and the German types, and it is open to theory to claim for either any measure of superiority whatever. Meanwhile, curved fire has rendered high caponiers extremely objectionable, especially where, as in certain cases in this country, the floor of the upper tier was formed only of joists and planks.

While, in Prussia, the polygonal type of *enceinte* was followed throughout the first half of the 19th century, a somewhat new point of departure was made in Austria by the Archduke Maximilian. Linz, an important strategic point on the Danube, was fortified by forty-two towers, commenced in 1830. The towers—now falling into ruins—are strong casemated buildings, circular on plan. They are sunk into the rounded hills, and surrounded by deep revetted ditches with counterscarp galleries. The masonry is well covered, and the fire of the twelve guns mounted on the top was intended to graze the natural glacis in front. The towers are extremely inconspicuous, support each other well, and would have been capable of a strong Infantry defence if the guns were all disabled. Marmont states: "Covering an army shut up in the space embraced between them, they appear to me to be unattackable. The enemy can never dare to besiege them while they are supported by the army, and the army placed under their protection has nothing to fear." The Linz towers contained the germ of the modern entrenched camp, and were in many respects far superior to works subsequently constructed.

While the German or polygonal system was adopted in

nearly all the European fortresses constructed since the battle of Waterloo, the French retained the bastioned trace to a late date, and applied it to the defences of Paris, begun in 1840. As will be noticed subsequently, this "persistence of type" in a case to which it was pre-eminently unsuited resulted in works which clearly show how little their designers had studied the past history of siege warfare.

CHAPTER IV

RUSSO-TURKISH WAR OF 1828-29—BRAILA, VARNA, SILISTRIA, SCHUMLA—SILISTRIA, 1854—SEBASTOPOL—KARS

THE Russo-Turkish war of 1828-29 produced some specially interesting sieges, and at one period of the first campaign the whole Russian army was occupied in besieging Schumla, Silistria, and Varna. These fortresses were all of the most elementary nature, simple bastioned fronts without ravelins or outworks of any kind.

Braila, "by far the strongest place on the lower Danube,"[1] garrisoned by 7,000 to 8,000 Turks, was besieged in May and June, 1828, by a force of 18,000 Russians with a siege train of 100 guns, aided by a gunboat flotilla. The siege was carried on in regular form which proved most perplexing to the Turks, to whom the principles laid down by Vauban were unknown. Arrived at the glacis, the besiegers resorted to mining, and succeeded in making a practicable breach. The assault which followed was, however, repulsed with a loss of 2,000 men, and the Turks were even able to carry out a partial pursuit. After a resistance of thirty-seven days, Soliman Pasha surrendered with a museum of obsolete ordnance of all countries. During the siege, which cost the Russians 4,000 men, the 7-pr. Coehorn mortars appear to have been the only effective Artillery used by the Turks.

Varna had an *enceinte*, resting on the Black Sea, and con-

[1] The Russians in Bulgaria and Roumelia in 1828-29.—Von Moltke.

sisting of ten bastions of simplest form with little one-gun flanks. Nearly " one whole front was destroyed by mines " ; but no general assault was delivered, and the Turks finally surrendered after a resistance of sixty-eight days. Russian ships co-operated with the besieging force by shelling the town.

The older defences of Silistria were razed in 1810; but the town, which was "equally important in a strategic point of view, and unfavourable for purposes of Fortification," had been re-fortified in the simplest way. The command of the rampart was only nine feet; the scarps and counterscarps were ten feet high, faced with flints. Even the covered way was incomplete. The garrison was 6,000 to 7,000 strong, "principally armed inhabitants of the town and its neighbourhood."[1] The Russians, numbering 30,000, and supported by the Danube flotilla, carried on a regular siege for 112 days, ultimately retiring with the approach of winter, having effected nothing except parallels and approaches.

Turkish apathy sufficed to prevent any real improvement of the defences, and, when again besieged in 1829, Silistria had received only the addition of a few " mere earthworks or lodgments." The garrison, however, had been increased to a strength estimated, "perhaps too highly," at 13,000. Warned by the experiences of Braila, the Russians carefully eschewed assaults and resorted to mining on a large scale. Divided counsels appear to have prevailed in the town, and after sending pigeons to the Vizier at Schumla, Sert Mahomed Pasha surrendered, the siege having lasted forty-four days, and nine days after a practicable breach had been made. Artillery fire played a subordinate part in the attack, and the defence is chiefly remarkable for the tenacity with which the Turks held their extemporized outworks.

Schumla, which was defended by field works only, was

[1] Von Moltke.

attacked in both campaigns, but was still holding out when peace was concluded before the gates of Constantinople.

Permanent Fortification in the cases of Braila, Varna, and Silistria, was reduced to its simplest form. There were neither technical advantages, nor advantages of position. Everything which theory has laid down as essential was absent. The Russians brought the formal attack to bear against an enemy who knew it not, and they showed no lack of bravery. According to all correct principles, therefore, the capture of these fortresses ought to have been a simple matter. Yet the average duration of the three successful sieges was forty-nine days, or sixteen days longer than the Peninsular record, and the weakest of the fortresses, Silistria, with a most indifferent garrison, repulsed the Russians effectually in 1828, and was captured in 1829, though held by a better garrison of nearly double strength.

What deduction can be drawn from the above facts except that, within broad limits, the nature of the defences matters little, and that sieges, like battles, are decided by general tactical considerations? The tenacity displayed by the defenders in these sieges is no peculiarly Turkish attribute, and was surpassed by the Spaniards at Saragossa, and rivalled by the Russians at Sebastopol. Nevertheless, the campaigns of 1828-29, and the further experiences of Silistria in 1854, and of Kars in 1855, if properly studied, might have saved the Russian general staff from some of the blunders of 1877-78.

The war of 1854-55, with which the era of smooth-bore Artillery ended, was an unbroken triumph of Fortification—the Fortification of the soldier, not that of the theorist. The operations all turned practically upon the defence of three entrenched positions, Silistria, Sebastopol, and Kars.

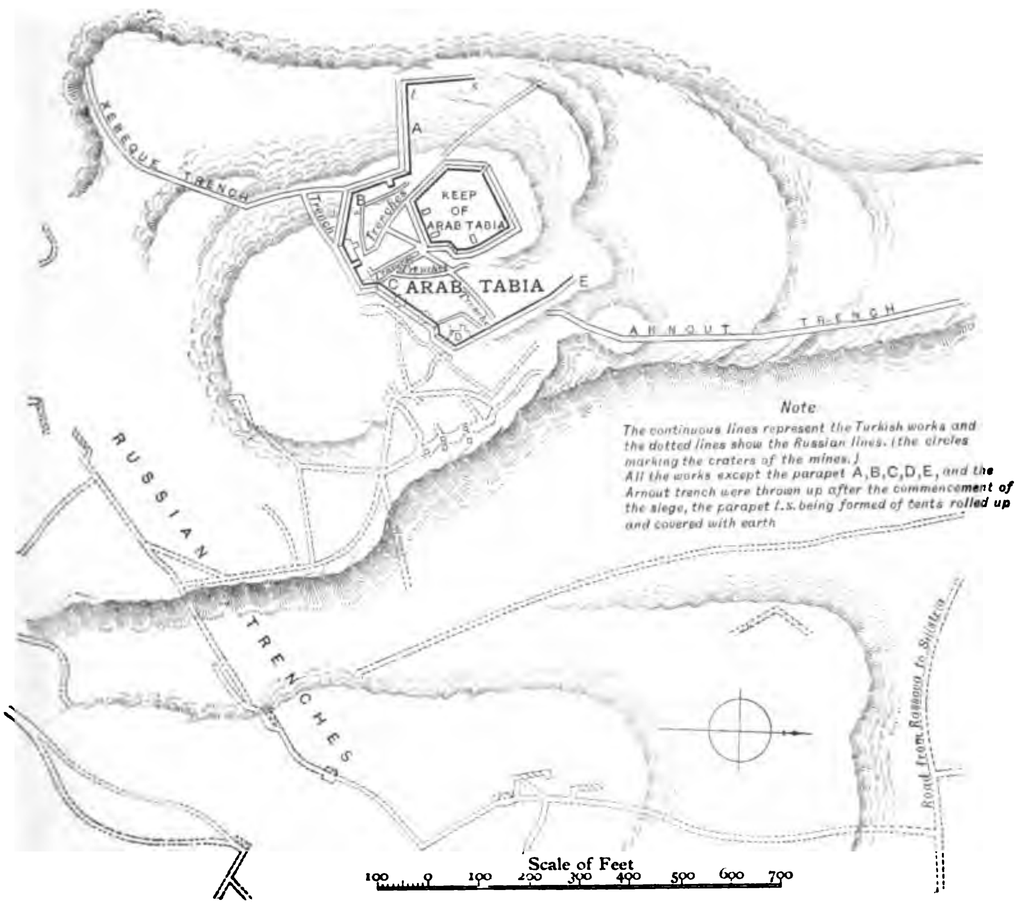
The *enceinte* of Silistria, which had distinguished itself so

signally in 1828-29, remained unchanged in 1853; but the heights commanding the town on the south and east had been occupied by detached works designed mainly by Colonel Grach, a Prussian officer in the Turkish service.[1] On these detached forts, but especially on a roughly constructed earthwork, Arab Tabia (Plate II.), the brunt of the attack fell. Towards the end of 1853 the Russians occupied an island in the Danube, from which they freely bombarded the town, "both previous to and during the whole siege, so much so that the sick had to be removed from the town and placed under canvas near Fort Medjidie; yet some of the enemy's shot reached them even there."[2] On the 16th May, 1854, the Russians arrived in front of the place, and the first parallel was begun the same night. The garrison of Arab Tabia was a promiscuous body—"three battalions of Arabs furnished by the Viceroy of Egypt, one battalion of Redifs, one company of newly organized Chasseurs, and about 1,000 Arnauts and Albanians." At three a.m. on the 29th May, Arab Tabia was assaulted, the Russians advancing "so rapidly that part of the storming party actually got inside the work, but they were repulsed with considerable loss." The assault was twice repeated and as often defeated, the total loss of the assailants being about 2,000 men. The Russians thenceforward avoided assaults, but prosecuted the regular siege of this simple earthwork with much vigour, and fired their first mine on the 2nd June, which, "owing to some mismanagement, exploded backwards." The defenders, having no tools, were unable to countermine. On the 10th June, the Russians fired a mine under Bastion D (Plate II)., and effected an entrance into the retrenchment, only to find an inner line, by the fire from which they were completely repulsed. On the 23rd, "after a tremendous bombardment,"

[1] "Invasion of the Crimea."—Kinglake.

[2] Major Nasmyth. "R.E. Professional Papers," vol. vi., 1857.

PLATE II.



Defences of Silistria, 1858.

Arab Tabia.

[To face page 80.

the whole besieging force recrossed the Danube and definitely retired.

The successful defence of Silistria, and of Arab Tabia in particular, was mainly due to Captains Nasmyth and Butler; but the whole operation well illustrates the difference between the teaching of theory and that of war. A town, subject to bombardment throughout the siege; six detached forts of simple design unconnected by trenches; one advanced work (Arab Tabia), open at the gorge and having a ditch 6 feet 9 inches deep not palisaded; a motley garrison of about 12,000 men, subsequently reinforced by some Bashi-Bazouks—these were the conditions in which an army of 60,000 men was completely repulsed, and the wave of Russian invasion was hopelessly broken.

The difficulties experienced by Prince Paskievitch's force before Silistria were soon to be painfully realized by the Allies before Sebastopol.

This memorable siege has a bearing on Fortification which has never yet been fully recognised, although the fine history bequeathed to us by Todleben[1] has enabled the operations to be studied in detail from the side of the defence.

Of permanent land defences on the south side of Sebastopol there were practically none. The project of 1832 had been carried out only in the case of the large barracks which were intended to form part of the gorges of the principal bastions. In the spring of 1854 steps were taken to protect the town "*contre une tentative de descente opérée par un faible corps de troupes.*" Loopholed walls, barricades, and a few simple batteries, gradually developed into a vast system of earthworks such as the world had never seen. Plates III. and IV. serve well to illustrate this growth in the case of Bastion No. 3, familiar as the "Redan." By September

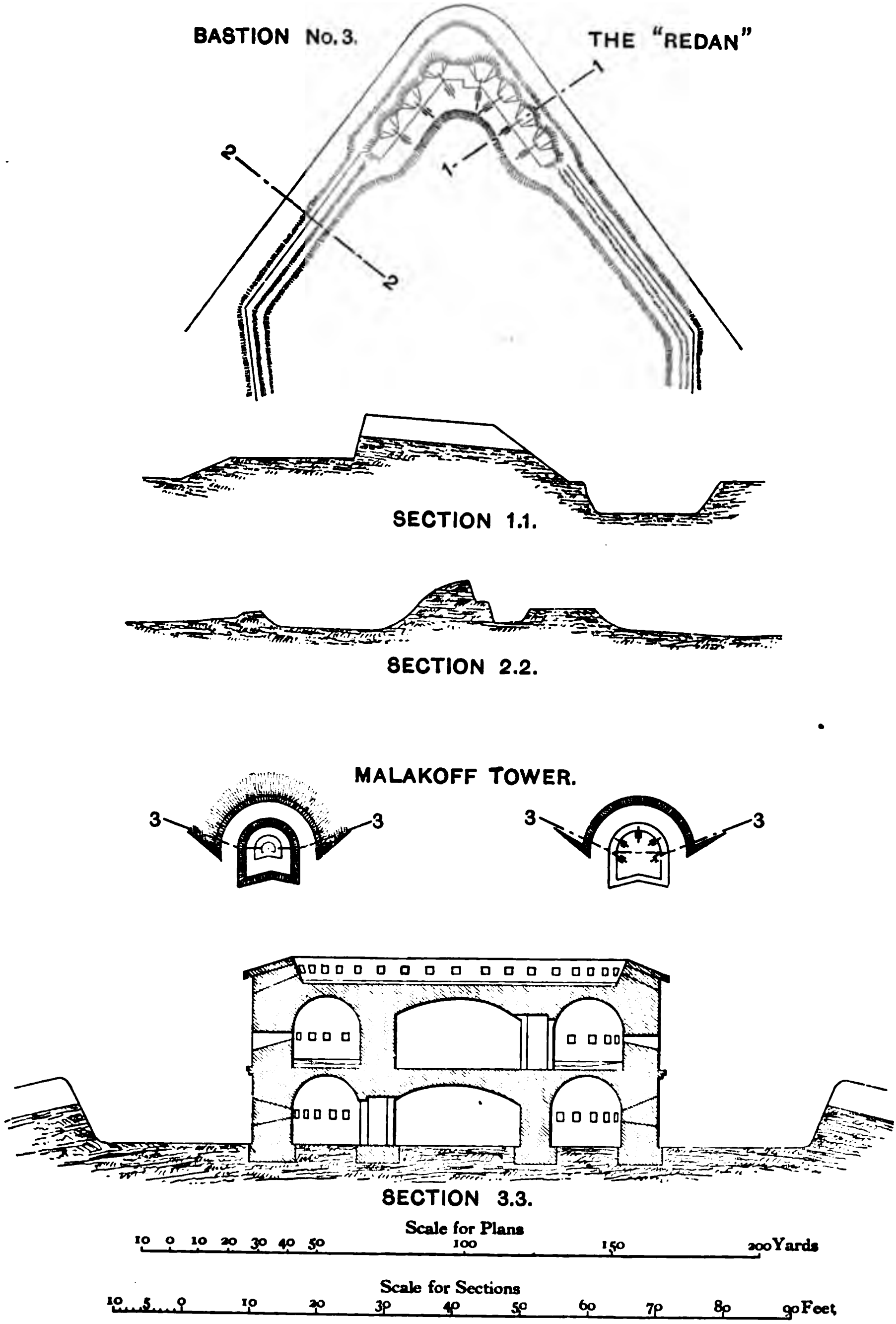
[1] "La défense de Sebastopol," 1863.

the defences of the south side mounted 172 guns ready to oppose the 126 guns of the Allies in the first bombardment begun on the 17th October.

It was expected that Sebastopol would fall "after a short cannonade."[1] The siege lasted 349 days, and at its close the Russians opposed 982 guns in first line to about 800 guns of the Allies. Given the great resources available at Sebastopol and the decision of the allied generals to sit down before one side of it, there was little reason, judging from the past experience of war, to expect a rapid issue. Improvised defences, held by stubborn troops, had always developed great resisting power. Nevertheless, a resistance of nearly a year could hardly have been anticipated. Nothing in this memorable siege happened quite as it ought to have done, and half the cherished principles of the schoolmen were violated. Works of field profile ought to be easily stormed; only scarps thirty feet high gave adequate security against escalade. Even so, the ditches must be well flanked, and there should be no "undefended space," or "dead angles." The Artillery of the defence ought to be soon silenced by the siege batteries, disposed according to well-established rules. The case of defending forces possessing a large reserve of guns, and directed by a soldier of genius who knew how to employ them, had not been taken into account. Instead of being shut within the line of their works, and able only to execute occasional sorties, the Russians usurped the recognised prerogative of the besiegers as regards trench work, even taking up new ground and commencing such an important advanced work as the Mamelon nearly six months after the siege had begun.[2]

[1] "Campaign of Sebastopol."—Hamley.

[2] "The Allies are fixed in the Tauric Chersonese at very close quarters, and as it were besieged by the Russians."—Letter from Von Moltke to his brother Adolf, 12th December, 1855.



DEFENCES OF SEBASTOPOL, 25TH SEPTEMBER, 1854.

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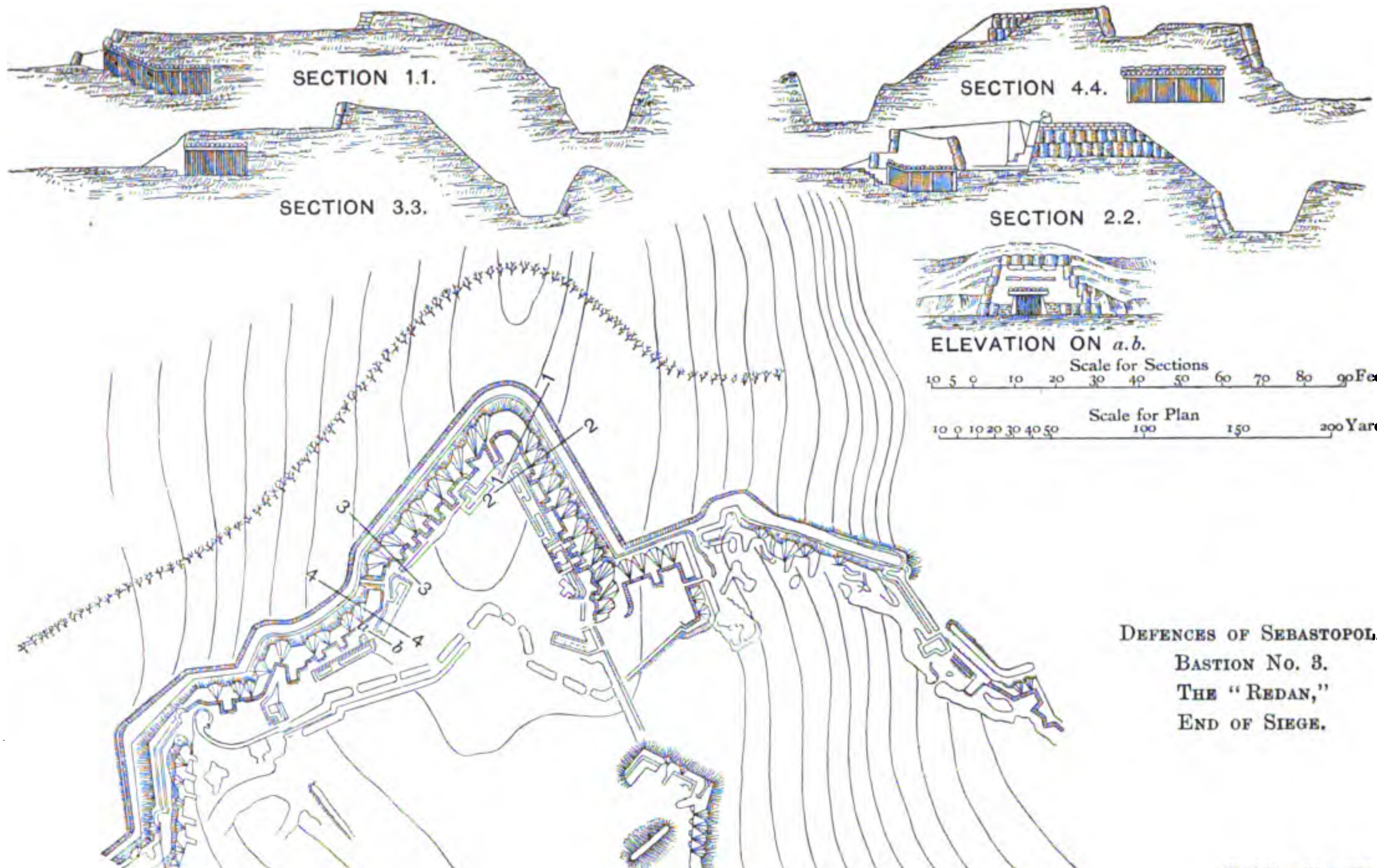
PLATE IV.



DEFENCES OF SEBASTOPOL.
BASTION NO. 3.
THE "REDAN,"
END OF SIEGE.

[To follow Plate III.

The whole proceedings were thus irregular and informal, possessing little in common with the attack as taught in military schools. "In advancing on a regular fortress the works of the besieger are not exposed to the fire of those bastions or salients not attacked, and his attention is directed solely on the two salients before him, and the ravelin or other outwork covering the curtain which connects them, the number of guns in which being determinate, they are always overpowered by the superior number brought against them. The sap proceeds slowly and surely till sufficiently near, when the breaching batteries or the mine open the road through the defences for the stormers."[1] If Sebastopol had only been regularly fortified on some approved system, the course of the besiegers would have been plain. But here "the appellation of siege applied to our operations may almost be considered as a misnomer; it may rather be said that we were attacking an entrenched position."[2]

In any case, the splendid defence which Todleben conducted, and the surprising results obtained by simple earthworks steadily developed in the presence of the besiegers, produced a profound impression. It was realized that in a sense permanent works of the much-loved types were discredited, and their champions at once took the field on their behalf. The efficiency of field works, which had been demonstrated to an unexpected extent, thus produced the partial paradox of a fresh defence of permanent Fortification as its principal literary result.

Of the writers who urged this view, none put the case so well as Todleben himself, who pointed out with great force that the plan of defence to which he was driven by stress of circumstances necessitated the daily employment of working parties of from 5,000 to 10,000 men, whose losses were frequently severe. And, further, the want of good casemate

[1] "Campaign of Sebastopol."—Hamley. [2] *Ibid.*

cover, which would have enabled strong bodies of troops to be kept close to the points where their presence was required, entailed the constant provision of large reserves in rear, which, being more or less exposed, suffered considerably. Moreover, such reserves having long distances to traverse, could not always be brought up to the moment, as was proved in the French attack on the Mamelon on the 7th June. It was impossible to keep an adequate force in the Mamelon under the crushing fire of the siege batteries. The feeble garrison was easily overpowered, and the reserves came up too late to save the work, though in time to hold the Malakhoff, and to capture a number of prisoners.

It is quite certain that the defence of Sebastopol supplies no argument for leaving a national arsenal without defences; but, on the other hand, this great siege, carefully studied, indicates that the necessary fortifications might have been of a very different type from anything that the professors would have adopted. If the siege of Sebastopol means anything, it is that the vast ditches, the monumental revetments, the clever drawbridges, the fantastic traces, the exaggerated flank defence, all the luxuries of engineering fancy, are superfluous.[1] Had the tactical points of the south front been occupied by strong earth redoubts of the simplest trace without revetted ditches, but with a liberal provision of efficient obstacles, possessing good bomb-proofs—not barracks with officers' mess-rooms and infant schools complete —all the requirements of permanent defence would have

[1] One of the text-books gravely pointed out: "Still the fact remains that the works which made this memorable defence were never proof against assault." The defences of Sebastopol, in fact, fulfilled the conditions of war, but not those prescribed by theory. Only one of the works in the main line—the Malakhoff—was ever taken, and on the same day the attack on the Little Redan was repulsed with a loss of 4,000 men. Yet the Little Redan was "never proof against assault."

been cheaply and effectively fulfilled. Given such strongly built closed works as his key points, instead of being obliged, under fire, to create them gradually and imperfectly in rear of his lines, a general inferior to Todleben would have made a longer defence with a far less expenditure of life and labour.

It is worth noticing that the one completed permanent work on the south side of Sebastopol was the Malakhoff Tower (Plate III.), built by *La Marine*, at the cost of the merchants of the town. This work, which was distinctly inferior in conception to the Linz Towers of much earlier date, proved disadvantageous to the besiegers in all respects. The Malakhoff redoubt, which was fitted round it, suffered in trace. The upper story of the Tower was speedily cut down by the siege guns of the Allies. Even when thus improved by the enemy's fire, the splinters from the truncated wall caused serious casualties to the gunners in the batteries in front. The structure was, however, doubtless dignified with the name of a "keep"—a euphemism applied to similar atrocities of later date. As a keep, it justified its existence by allowing a handful of Russians to hold out uselessly for a few minutes after the French had captured the work. The lesson of the Malakhoff Tower seems to be sufficiently clear; but the traditions of the Middle Ages are persistent. In a battery at Gibraltar constructed more than twenty years after the siege of Sebastopol, the guns were made to nestle close under a tall stone lighthouse; while in Landguard Fort the vicious principle on account of which the Russians paid dearly was faithfully reproduced. The Egyptians—who may be pardoned perhaps—mounted several of their best guns at Alexandria under the shadow of venerable towers, and suffered accordingly in the naval attack of the 11th July, 1882.

Other practical lessons may be learned from Sebastopol,

however. An indifferent *abatis* proved the power of an obstacle under musketry fire in resisting an assault. Mines employed on a large scale showed to the best advantage on the side of the defence. Field guns brought up to the parapet at the last moment rendered useful assistance in the repulse of the second attack on the Malakhoff—"*avaient efficacement contribué à neutraliser l'impétuosité des assailants.*"[1]

While extemporized defences were successfully keeping the Allies at bay at Sebastopol, similar works were as effectually excluding the Russians from Kars. In 1828, Kars was surrendered by the Turks to Prince Paskievitch after a resistance of three days. Colonel Lake writes that in the condition in which he found the place "it is questionable whether they could have held it for three hours."[2] The exertions of a handful of British and Hungarian officers enabled it to be held for five months.

Kars was never besieged, and such permanent works as it could boast of were never attacked. Nevertheless, there are lessons to be derived which have a direct bearing on Fortification. The conditions were specially unfavourable for extemporized defence. The ground was principally rock, and the parapets were made of large stones covered with turf. Timber and brushwood were wanting, and Colonel Lake could not even provide stakes for the *trous de loup*, which formed his obstacles. The Turkish force of about 15,000 men, forming the garrison, had been signally defeated at Kuruk-Deri, in the previous year. When the British officers arrived, the greater part of the Infantry was "guileless of all knowledge of drill and discipline," and many of the officers were "ignorant even of the words of command." The men were in rags, and had not received pay for two

[1] Todleben.

[2] "Kars, and our Captivity in Russia."—Colonel Atwell Lake, 1856.

years. The Artillery alone was fairly efficient. With this garrison, General Williams completely repulsed the determined assault of Mouravieff's fine force of 35,000 men on the 29th September, 1855. The attack began just before daybreak, and the fighting lasted for seven hours. Three small works, not properly garrisoned,[1] were carried. "Had they been only ordinarily manned, they would never have been taken."[2] The Russians were completely defeated with a loss of more than 10,000 men, although the whole Turkish force engaged was under 7,000, and its loss only 1,200. The Artillery of the defence contributed largely to this result. Strange to say, all the rest of the works attacked, though remaining absolutely inviolate, were not theoretically "*sturmfrei*," and had neither caponiers nor flanked ditches. And, curiously enough, of the works temporarily captured, because inadequately garrisoned, the only one which was open to the rear "held out long after" the fall of the others, and was only retained "by the enemy for a few minutes."[3]

It is worth while to compare the assault of Kars with that of Badajos on the night of the 6th-7th April, 1812. With less than 7,000 men engaged, Colonel Lake's simple earthworks, constructed in great measure after the arrival of the Russians, completely repulsed an attack in overwhelming force, inflicting a loss of 10,000 on the assailants. On the other hand, Badajos, the strongest fortress in the Peninsula attacked by the British Army, fell to a combined escalade and assault of the breaches. The strength of the garrison was 4,071 all told. The whole of it was practically engaged, and the loss inflicted upon the assaulting columns was 3,661. At Kars, therefore, the defenders, in

[1] Colonel Lake points out that two of them were badly placed.

[2] Lake.

[3] It would, of course, be preposterous to claim this fact as an argument in favour of open works; yet parallel deductions, equally worthless, have been drawn from the accidents of war.

field works, inflicted a loss of nearly one and a half per head, and utterly defeated the attack. At Badajos, defended by permanent Fortification, the loss inflicted was nearly one per head of the garrison, and the attack was successful. Comparing the quality of the two garrisons, the advantage should certainly be on the side of the defenders of Badajos, who belonged to the most highly trained army in Europe, and against any moral effect which the loss of Fort Picurina, twelve days previously, and the bombardment, may have caused to the French, must be set the long and weary blockade, the cholera, and the actual want experienced by the Turks at Kars.

Direct comparisons are never possible; but the above considerations supply a useful corrective to much that has been written in regard to permanent Fortification, and they should unquestionably inculcate caution in arbitrarily laying down the conditions of storm freedom. "*Sturmfrei*" defences are after all those which cannot be stormed, and Kars, like Plevna and other roughly entrenched positions all the world over, proves the practical inadequacy of the maxims of the schoolmen. It is quite certain that a Kars, permanently fortified according to the approved methods of 1855, would not have held out one day longer. It is not certain that, in the great assault, a bastioned *enceinte* of the Badajos standard would have served the purpose of the defenders so perfectly as did the extemporized defences designed to meet the needs of the moment.

With the fall of Sebastopol and of Kars the age of smoothbore Artillery and small-arms practically ended.

CHAPTER V

INTRODUCTION OF RIFLED ARMS—COMPARISON OF SHELL-POWER—AMERICAN CIVIL WAR—FORTS PULASKI, HENRY DONELSON, WAGNER — VICKSBURG — FORT FISHER — PETERSBURG—ATLANTA

THE introduction of rifled arms inevitably entailed great changes in permanent Fortification; but it by no means followed that the defence thereby lost in relative power. Theory, however, at once rushed to the opinion that the Engineer was heavily handicapped, that heroic remedies were required to restore the balance, and that the new requirements could only be met by extravagant outlay and a large recourse to iron or steel. The teaching of war, so far, points in precisely the opposite direction.

The increased range of modern arms has only a subordinate responsibility for the changes that became necessary. The civil buildings of the fortified towns of the Marlborough era pressed close against the encircling lines. Projectiles from the siege batteries were not necessarily spent when they reached the ramparts, and these towns frequently suffered severe bombardments. In 1792, the Duke of Saxe threw 30,000 hot shot and 6,000 shell into Lille in 140 hours, a performance which it would be difficult to surpass to-day.[1]

[1] During the period of hottest bombardment of Strasburg in 1870, the average rate of fire was about 6,000 projectiles in twenty-four hours.

The 24-pr. S.B. ranged more than 3,000 yards, and in 1840, when the Paris project of defence was under discussion, it was pointed out by General Noizet that the city could be bombarded from the heights of Chatillon, where thirty years afterwards the German siege batteries were actually placed. It is clear, therefore, that the destructive effect of modern fire, and not increase of range alone, has expanded the zone of defence. At the same time, a growing humanitarianism tends in the direction of exacting less endurance from a civil population, and consequently demands from Fortification longer lines of defence.

The following table, considered in connection with the relatively high remaining velocities, the effect in certain conditions of high explosives, and the improvement of fuzes, fully explains the increase of the possible effects of Artillery fire :

Bursting Charge of Shells.			
Smooth-bore Guns.		B.L. Rifled (1906).	Lyddite.
24-pr. - - -	13 oz.	9·45-in.[1] (howitzer, Austrian) - -	$58\frac{1}{8}$ lb.
18-pr. - - -	10 ,,	6-in. (gun) - -	$10\frac{6}{16}$,,
8-in. howitzer - -	$2\frac{1}{4}$ lb.	6-in. (howitzer) - -	$18\frac{3}{4}$,,
10-in. ,, - -	$6\frac{1}{4}$,,	5·4-in. (howitzer) -	$12\frac{3}{4}$,,
		5-in. 60-pr. (gun) -	$7\frac{1}{8}$,,
		5-in. (howitzer) - -	10 ,,
		4·7-in. (gun) - -	$6\frac{3}{4}$,,

Briefly, the changed conditions which Fortification, since the Crimean War, has been called upon to face *and to utilize* are due to increase in shell-power, range, accuracy, speed

[1] Sent to South Africa. The shell of the 11-inch howitzers employed by the Japanese at Port Arthur carried a bursting charge of $39\frac{3}{4}$ lb. of high explosive powder.

of fire, and penetrative effect, both of Artillery and small-arms.

As regards the design and general conception of land-works of defence, the most potent factors are the development of the accurate curved fire of Artillery, the great increase of the rate of fire of small-arms, and the adoption of the machine gun. The first is sometimes assumed to have conferred preponderating advantage on the attack, and the assumption is true so long as the older ideas of Fortification remain, and the tactical conduct of the defence is insufficiently studied. The second has conferred great advantages on the defence, as the experience of war has already proved, even where the trammels of the past were in full force. The third has not entirely answered expectations, but was used with some effect at Port Arthur.

Railway communication, which, anticipating rifled weapons by a few years only, developed *pari passu*, constitutes a factor of a different kind, but hardly less important.

The first siege operations in which rifled Artillery played any real part took place—not inappropriately—in the New World; but meanwhile the powers of the early rifled guns were carefully tested in the mock siege of Juliers in 1860. This siege of a practicable fortress is thoroughly characteristic of the inimitable seriousness of purpose which characterizes the German mind, and the experience gained was of much importance at the moment. The results proved the superiority of the new guns for breaching purposes, and showed that a detached wall completely invisible could be brought down with little difficulty by projectiles having a fall of 1 in 13. The following comparative statement[1]

[1] Editorial note to paper by Lieutenant-Colonel A. Ross.—R.E. Corps Papers, vol. x., 1861.

gives some indication of the advance in the power of Artillery :

Experiments.	Range.	Total Weight of Projectiles Fired.	Width of Breach.	Weight of Projectiles per Linear Foot of Breach.
	yds.	*lb.*	*feet.*	*lb.*
1. *Woolwich*, 1824.—Independent brick wall 7 feet thick between piers 21 feet high	500	660,100	100	6,601
2. *Juliers*, 1860.—Independent counterarched brick wall 3 feet thick between piers 16 feet high	640	3,588	32	111

The experiences of the American war are full of interest, and have perhaps received insufficient attention. Never before was so much originality displayed during a period of hostilities, and Europe owes much to the ingenuity evolved at this time of dire national necessity. The authorship has not in all cases been adequately acknowledged, and we have since re-invented some of the commonplaces of the transatlantic operations.[1] While the direct teaching in relation to permanent Fortification was naturally small, the indirect teaching fully confirmed previous experience.

Fort Pulaski on Cockspur Island was one of the few permanent works which came into conflict with the early rifled siege guns. The work was built of brick with one tier of guns in casemates and another *en barbette*. In addition to nature's liberal provision in the matter of water, there was a large wet ditch, doubtless intended to prevent the fort from being "captured with a rush by a landing party." "The probability of reducing it by the fire of ships was not even discussed";[2] and the work surrendered on the

[1] *E.g.*, the gas-check before which fell the barbarous system of studs.

[2] "Report on Siege of Charleston."—General Gillmore.

11th April, 1862, after a bombardment of 5,275 rounds from thirty-six guns, of which ten were rifled, the heaviest being an 84-pr. The fort was ruined and a breach effected at 1,700 yards, the siege guns being served by the Rhode Island volunteers, who had been drilled but "never practised in firing."

Into the cases of Forts Henry and Donelson, captured by General Grant in 1862, questions of land Fortification scarcely enter. Fort Henry on the Tennessee was severely bombarded by Commodore Foote with seven gunboats on the 6th April, and surrendered at discretion to the land forces with a garrison of sixty men. "The rest of the garrison had been stationed in the outworks, about two miles off, to avoid the fire of the gunboats; and before the fight began, Tilghman sent them orders to retreat upon Fort Donelson, which they obeyed."[1]

Fort Donelson, on the Cumberland, was engaged on the 14th April, 1862, by Foote, with six gunboats, which were "so disabled as to be unfit to take any part of importance in the succeeding operations." On the 15th, the Confederate garrison made an unsuccessful attempt to break through the investing force, which numbered 27,000 men. Donelson surrendered on the following day after a unique council of war, at which the command was successively handed over from Floyd to Buckner and from Buckner to Pillow.

Fort Wagner on Morris Island was a provisional work constructed in sand with one bastioned front about 300 yards long, parapets 16 feet thick, and bomb-proofs capable of sheltering at least 1,500 men. The besieging force was landed in the vicinity. Assaults were delivered on the 11th and 18th July, 1863, which were completely repulsed, the Confederates remaining in their extemporized bomb-proof to the last, and then manning the parapet and delivering a

[1] "Life of Grant."—Badeau.

hot rifle fire. At the time of these assaults, there were no exterior obstacles; but land mines were subsequently placed 200 yards in advance of the work. A regular siege was then carried on, forty-five guns, of which thirteen were rifled Parrott's (100-prs., 200-prs., and one 300-pr.[1]), being placed in battery at ranges of from 820 to 1,900 yards. In all, 1,173 projectiles, 100-pr. and upwards, struck the bomb-proof, which was not, however, opened out, and the effect on the sand parapets generally was very small. High-angle fire was employed in these operations, an 8-in. rifled gun, which ultimately burst, being fired at 30° 30′ "constant elevation." On account of the narrow front over which the besiegers were compelled to operate, the siege batteries fired over each other; but "no such demoralizing effect on the troops in the advance was experienced as had been anticipated by some,"[2] notwithstanding that premature bursts of shells from this virtually experimental ordnance were unpleasantly frequent. In the final bombardment, which began on the 5th September and lasted forty-two hours, the New Ironsides "with remarkable regularity and precision kept up an almost incessant stream of 11-in. shells." The Artillery of the defence was almost useless with the exception of two mortars (8-in. and 10-in. S.B.), which "when earnestly served caused the most serious delay in the progress of our work, and on one occasion suspended it entirely."[3] Fort Wagner was surrendered on

[1] The shell of this gun carried a bursting charge of 17 pounds.

[2] General Gillmore.

[3] General Gillmore. Similar testimony is forthcoming in the case of a single 8-in. mortar at York Town. In the battle of Petersburg Mine ten 10-in. mortars at 800 yards completely silenced a Confederate battery directly the range was obtained. At Petersburg, also, a 13-in. mortar was fired off a railway platform truck with great effect. The garrison of Fort Issy in 1870 feared the fire of battery No. 23, mounting four 50-pr. smooth-bore mortars, more than anything else.—Heyde and Froese.

the 7th September after a good resistance of fifty-eight days. The difficulties of the siege, which were considerable, were overcome with a skill and readiness of resource which the most highly trained force in Europe could not have excelled.

Vicksburg was defended by a chain of simple field works between seven and eight miles long. A line of rough rifle trench connected the works, which were irregular in trace and closed at the gorge in one case only. Vicksburg, which like Kars in 1877 held a defeated army, was ineffectively bombarded in June, 1862, by Farragut's fleet in the Mississippi. It was then assaulted on the land side by Sherman on the 29th December, 1862, and by Grant on the 19th and 21st May, 1863, in the latter case, after a heavy bombardment by land and river, lasting till 11 a.m. All the assaults were repulsed with heavy loss. In the second, a few works were captured, but could not be held, and the greater part of the attacking force never reached the lines. In the third, the distance to be crossed under fire varied between 80 and 400 yards. On this day, Pemberton had about 18,500 men in his lines, and lost about 800. Grant had about 30,000 men engaged, and his force was almost exactly decimated.

A regular siege was begun on the 23rd May, and mining was attempted on a small scale and without success. The besiegers had 220 guns (mainly field guns) in position; but the Confederates scarcely used Artillery fire at all, and made little attempt to hinder the trench work. By the 1st July, the approaches reached the ditches of some of the works. On the 4th, Pemberton, who had run short of food and ammunition, surrendered after a memorable defence of 213 days.

Fort Fisher, a temporary sandwork with guns all mounted *en barbette*, but possessing good bomb-proof cover for the garrison, suffered probably the heaviest bombardment on

record. On the 24th December, 1864, Admiral Porter shelled the work with thirty-three vessels, the average rate of fire being 115 projectiles per minute. The guns were "temporarily silenced, it being, indeed, impossible for anything human to stand under the torrent of missiles falling into and bursting over the work."[1] On the 25th, the fire of the ships reopened and was continued for seven hours, the fort replying slowly. The Federals then landed a large force and attempted to assault, "the fleet at the same time making a concentrated and tremendous enfilading fire on the curtain." The garrison, however, as soon as the fire necessarily slackened, was able to man the parapets in time to repulse the attack. In spite of this severe hammering, "many engineers and officers report Fort Fisher . . . as substantially uninjured as a defensive position."[2] On the 13th January, 1865, Porter again opened "a very rapid severe fire from forty-four ships," which was kept up during the night by the monitors and "New Ironsides." On the 14th, the fire recommenced at 1 p.m. and was maintained "till long after dark." On the 15th, the bombardment opened at noon and was "kept up furiously all day ; yet the 'Mound Battery' of the fort could not be hindered from answering most gallantly." Late in the evening, a party of 2,000 seamen and marines were landed and assaulted the work on the sea-front, but received a severe repulse. The garrison, however, which had concentrated on the side thus threatened, was surprised and taken in reverse by an attack in force by General Terry's troops, and Fort Fisher fell after severe fighting.

The facts above recorded appear to show that the moral effect of Artillery fire is insignificant where adequate cover exists, and, further, that the fire of ships even under favour-

[1] "Coast Defence."—Von Scheliha.

[2] General Butler.

able conditions and in overwhelming force is unable to incapacitate an earthwork for Infantry defence. Fort Fisher was specially ill-qualified to resist assault on the land side, since the neighbouring forest had not been sufficiently cleared, while a sand mound provided cover for the attack within a short distance of the parapet.

Petersburg, the Confederate Sebastopol, was defended by field works mainly constructed after the arrival of the besiegers. Telegraphing on the 7th June, 1864, four days after the battle of Cold Harbour, and while the army of the Potomac was still on the north bank of the Chickahominy, General Beauregard alludes to the position as "nearly defenceless," and liable, in the event of a movement against Richmond, to be "captured before it could be reinforced." On the 9th June, Gillmore with 2,000 Infantry and Kautz with 1,500 Cavalry were sent to attempt to capture the town. Gillmore reported the works "too strong to assault,"[1] but Kautz appears to have entered Petersburg on the south side, being then compelled to retire. On the 14th, Grant telegraphed to Washington: "Enemy show no signs of yet having brought troops to the south side of Richmond. I will have Petersburg secured, if possible, before they get there in much force." Accordingly, Smith with 18,000 men, supported by Hancock with 28,000, was ordered to take the position. Smith's command attacked and carried a portion of the lines on the 15th, before Lee's reinforcements could arrive. The advantage was not followed up. Further attacks took place on the 16th, 17th, and 18th, the whole of the 2nd Corps being present. The losses amounted to 6,000 men, but the "only result was to force the enemy into an interior line from which he could not be dislodged." Beauregard had saved Petersburg.

A partial investment followed, with occasional fighting on

[1] "Life of Grant."—Badeau.

a small scale. Meanwhile a siege train of 46 guns (30-prs. and six 100-pr. Parrott's) with about 60 mortars had been placed in battery. A Confederate work in front of the 9th Corps was mined and blown into the air at 4.30 a.m. on the 30th June,[1] and after a heavy bombardment, Meade's troops delivered an assault, experiencing some difficulty in getting clear of their own line of *abatis*. Severe fighting took place, in which the Northern force was completely repulsed with a loss of 4,400 men and many prisoners, notwithstanding that Grant stated: "Such an opportunity of carrying fortifications I have never seen." On the 18th August, the Weldon railway was seized by Warren, thus seriously crippling the sources of supply of Richmond.

The works on both sides round Petersburg subsequently assumed vast proportions, and by the 25th January, 1865, Grant opposed about 111,000 men to 70,000 Confederates in Petersburg and Richmond.[2] On this day Lee attacked Fort Steadman, a small work at a point where the opposing lines were only 150 yards apart. This work, held by a force of garrison Artillery only, was captured, but subsequently retaken. On the 31st March was fought the battle of Five Forks, brought on by an offensive movement on the part of the Confederates. Early in the evening of the 2nd April a fresh assault was delivered, resulting in the capture of a portion of the lines together with Forts Gregg and Baldwin. The former, with a mixed garrison only 300 strong, made a determined resistance against overwhelming numbers; the latter was evacuated. At the same time, the two attacks

[1] The main gallery of this mine, which was driven under many difficulties, was 510 feet long, and the charge 8,000 pounds of powder. The crater formed was "150 to 200 feet long, about 60 feet in width, and from 25 to 30 feet in depth, presenting a serious obstacle to the passage of troops."—"Report on Conduct of the War."

[2] According to Badeau; different figures have been put forward.

made by Miles were totally repulsed. On the following day, Lee abandoned Petersburg and Richmond.

The general character of the fighting round Richmond resembled that before Sebastopol, and the difference which might have been expected from the substitution of rifled Artillery and small-arms for smooth-bores was not marked. The Artillery at Petersburg played a far less important part than at Sebastopol. The soil was much more favourable for trench work in the former case, which conferred advantages as great on the attack as on the defence. The possibilities open to good earthworks were again manifested, although Lee had no Todleben.

Atlanta, unlike Petersburg, had the great advantage of being carefully fortified before the Northern army arrived, and no attempt to assault the works was ever made. Sherman with about 80,000 men reached the place on the 22nd July, 1864, and on the 28th the Confederates came out of their works and attacked the investing force, but were repulsed. On the 7th August, Sherman telegraphed to Grant: "We keep hammering away all the time and there is no peace inside or outside of Atlanta . . . will push forward daily by parallels and make the inside of Atlanta too hot to be endured." "Hood seemed determined to hold his forts," however, and sent out his Cavalry to cut the railway in rear of the besiegers. The siege made little way, and on the 25th August, Sherman moved the bulk of his army to the east, cutting the West Point railroad. This turning movement caused the evacuation of Atlanta on the 2nd September, Hood escaping to the south.

The provisional works of Atlanta thus made a resistance of forty-one days, and served their purpose as forts quite as perfectly as the most costly erections copied from Antwerp would have done.

CHAPTER VI

DÜPPEL—FRANCO-GERMAN WAR, 1870-71—GENERAL RESULTS OF GERMAN SIEGE OPERATIONS—PARIS, FORT ISSY, HAUTES BRUYÈRES REDOUBT—BELFORT—GENERAL DEDUCTIONS FROM THE SIEGE OPERATIONS OF THE WAR

THE siege of Düppel in 1864 was a particularly easy operation; since the besiegers were in uninterrupted possession of railway communication with Holstein, and the heaviest siege guns could be brought from Eastern Prussia and placed in battery before the Danish lines within ten days.[1] The defences, on a line 3,000 yards long, consisted of ten small redoubts, of which three were open to the rear. The largest work had about 14,000 square feet of terreplein. The command was 15 feet; the ditches were palisaded and unflanked. In the gorges were blockhouses of stereotyped pattern, with earth on the roofs, standing well above the crest line, visible for miles, and presenting ideal targets to the enemy's siege guns. The redoubts were connected by a rifle trench of slight profile, and a few rifle pits and picquet posts had been established in front. There was a second line of works all open to the rear. The armament, including that of Alsen, consisted of 108 guns, of which 92 were smooth-bores, together with a few mortars. The guns fired through cramped embrasures in the redoubts.

The Prussians invested Düppel on the 12th February, and

[1] Rüstow.

opened fire on the 14th March from fifty-four guns, of which eighteen were smooth-bores. The first parallel was made at 1,200 paces from the lines and the third at 450. By the 13th April, the besiegers had 122 guns in battery, including forty-four smooth-bores. After a severe bombardment on the 17th April, the main line was stormed on the morning of the 18th, with a loss of 1,188 out of about 16,000 men engaged, and the disorganization produced by the successful assault sufficed to prevent the second line from being held.

The experiences of Düppel could be and were turned to account in the interests of theoretical storm-freedom, high revetments, colossal caponiers, intricate keeps, and drawbridges; but the real lessons were of another kind.

The lines of Düppel were stormed with comparative ease because there were few troops inside them, and in such circumstances most defences can be captured. It was quite impossible to keep garrisons in the works under the Prussian fire; but they were fully manned during the night of the 17th-18th in anticipation of an assault at dawn. The hour fixed for the attack was, however, 10 a.m., and the Danish commander, fearing a resumption of the bombardment at any moment, withdrew his garrisons, leaving only small Artillery detachments and weak Infantry picquets. Hence, in some cases, the redoubts were not garrisoned at the moment of attack, and in others the Prussians and the Danes arrived together, the former on a broad front by climbing the parapets, the latter through a narrow gorge opening.

The lines of Düppel were stormed simply because they violated an elementary law of Fortification dictated by copious experience of the past, and specially emphasized only ten years previously at Sebastopol. The Mamelon fell on 7th June, 1855, for want of defenders. The Redan was found to be unoccupied on the same day and for the same

reason. The attacks on the Mamelon and the Malakhoff in the early morning of the 18th June were defeated with heavy loss. Assaulted at noon on the 8th September, the Malakhoff fell, "almost without a struggle."[1]

A redoubt, of whatever kind, must either provide cover for its defenders under Artillery fire, or it must have an obstacle which will detain the enemy sufficiently long to enable the garrison, starting from their place of security, to line their parapets. If it were necessary or desirable that the Infantry garrisons should be kept at a considerable distance from their works, then evidently there exists an argument for deep ditches and for caponiers, provided always that picked men under trustworthy non-commissioned officers can be spared to man them.

The defence of the lines of Düppel practically received no assistance from Artillery fire, the Danish guns being hopelessly overmatched from the first; while, in their breech-loading rifle, the Prussians possessed a new source of power. The besiegers had, in fact, every conceivable advantage on their side. Far better works could have been made in three weeks; yet the defence lasted sixty-five days, thus easily beating the record of the great majority of the costly productions of the draughtsman's art. The performance of the Düppel earthworks, bad as they were, compares most favourably, for example, with the forty-five days' resistance of Strasburg in 1870, even when it is fully granted that, in the latter case, the bombardment of the town hastened the surrender. The poor little Danish redoubts, defended by smooth-bores opposed to rifled guns, by muzzle-loading small-arms opposed to breech-loaders, furnished no support for extreme views as to the real requirements of Fortification.

It is customary to speak somewhat slightingly of the performance of the French fortresses in the campaign of

[1] Hamley.

1870-71. With a few exceptions, they are commonly assumed to have fallen to brief bombardments by field guns, becoming thus available as illustrations of the power of rifled guns over Fortification, and indicating the necessity for armour in various forms, together with other artifices which appeal to a certain class of mind. On the other hand, the fate of these fortresses has also been regarded as attesting the inefficacy of Fortification generally, and the uselessness of fortresses in face of the conditions of modern war. But for the fortresses, however, the Germans would have swept France clear of all organized bodies of troops within three months of the frontier battles. Had Paris and Metz possessed two months' more food-supply the fortunes of the war might have been changed.

The French defences suffered from almost every conceivable disadvantage. Excluding the unfinished forts of Metz, the newest of the fortresses attacked—Paris—was thirty years old. The average age of the rest must have been more than 150 years! Though initially ill-found in all respects, and almost as completely unprepared for war as were, at this period and later, our own defences at home, few of these fortresses were improved or strengthened in the available time after the outbreak of hostilities. It is not easy to direct a defence effectively, and, with few exceptions,[1] France had not the men for the work. To meet siege trains thoroughly reorganized after the Danish war and brought fully up to date, the fortresses had no armaments worthy the name.

A number of men, even of disciplined troops, does not make a garrison, and in most cases the closely knit and carefully organized forces which a good defence requires were not available. Vitry, Toul, Laon, Schlettstadt, Neu Brisac, La Fère, Peronne, and Rocroy, were garrisoned almost

[1] Notably Colonel Denfert of Belfort fame.

entirely by *gardes mobiles*, who at Vitry had not received their uniforms, and at Schlettstadt were engaged in looting their compatriots when the Germans entered. Add to this that the fortresses were in almost every case single lines enclosing towns in which the civil population were exposed to the full effect of bombardment, and it seems clear that prolonged defences could scarcely be expected.

Judged by past standards, however, these hapless fortresses acquitted themselves creditably.

In Appendix E a précis of the siege operations of the war[1] is given, which brings to light the following facts :

1. The total number of fortresses detailed is twenty-four, and of these one (Bitsch) was never taken, and six (Lichtenberg, Lützelstein, Marsal, Vitry, Laon, Sedan) made practically no resistance.

2. The average duration of the defence of the remaining seventeen fortresses was forty-one days.[2] Excluding Paris and Metz, which held French armies, the average resistance of the remaining fifteen was thirty-three days.

3. The Germans employed siege guns in fourteen of the eighteen cases in which alone any resistance was offered.

4. Formal sieges were undertaken only at Belfort and Strasburg; partial sieges at Paris, Schlettstadt, and Longwy.[3]

From the above it appears that the average period of resistance of the French fortresses, excluding Paris and Metz, was the same as that of the fortresses which played a part in the Marlborough wars and in the Peninsula.[4] Including Paris and Metz, the era of rifled weapons actually

[1] The information is taken from Colonel von Tiedemann's work.

[2] Belfort is included, because, although surrendered by a clause in the armistice signed at Versailles on the 15th February, it could not have been held longer.

[3] In many other cases siege batteries were built, however, even for field guns.

[4] See pp. 10 and 12.

shows an increase of twenty per cent. in the time-endurance of permanent Fortification. Granted most freely that measurement in terms of days affords no absolute standard of comparison, the striking fact remains that in spite of every sort of disability the French fortresses, pitted against guns not dreamed of when they were built, acquitted themselves quite as well as the *chefs-d'œuvres* of the Vauban school in the days of their glory.

This affords no proof of the fitness of theoretical Fortification for the purposes of war at any period; but it unquestionably indicates that, as compared with the past, the defence had lost nothing under the conditions which obtained in 1870. At least the inference is inevitable that, up to this period, there was nothing to cause gloomy forebodings as to the future of Fortification, or to justify such a wholesale recourse to iron as has since found advocates.

It is willingly admitted that, except in certain cases, the siege operations of the Franco-German war were not pressed with any great vigour. Judging from the experience of Strasburg, however, there is no reason whatever to suppose that more rapid and striking results would have been secured by arduous trench work. The very reluctance of the Gèrmans to embark on such measures, even where speedy capture was a matter of great moment, constituted a strong proof of the existence of a belief that the siege even of an obsolete fortress is no easy task.

The siege operations of the 1870-71 campaign will repay a careful study by all who wish to base Fortification on the experience of war, and not on the promptings of the inner consciousness supported by diagrams. The main characteristics on the side of the attack were heavy bombardments, and an excessive reluctance to assault, even in cases where an early capture was extremely important and where the conditions were theoretically favourable. A single assault

was attempted against the provisional works of Belfort and failed. On the side of the defence, the Artillery was—as usual in the case of permanent Fortification—nearly impotent. The effects of the fire of the attack were uniformly small, except where the design of the works themselves was such as to ensure the maximum advantage to the enemy. Even on the towns, exposed as they were, the effects appear to have been moderate in many cases. In Paris, the total number of killed and wounded is given as 375,[1] and the fires which broke out seem to have been easily extinguished.

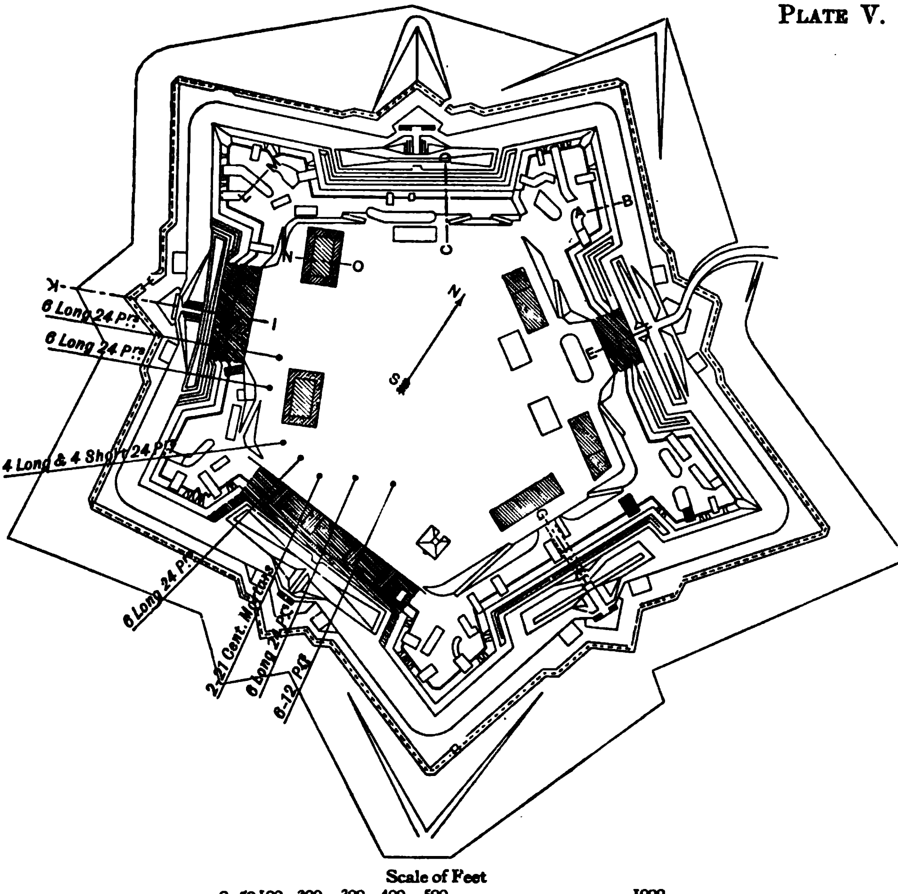
The want of casemate cover was severely felt in numerous instances. Only one case arose (Strasburg) in which mining operations might apparently have aided the defence, and of the possibilities thus offered, the French, unlike the Russians at Sebastopol, took no real advantage.[2]

Judging between attack and defence, from the experience of these and the earlier siege operations, it appears that while rifled Artillery conferred a certain advantage on the former, the breech-loading small-arm gave a greater advantage to the latter. This inference would not be a just one, however, since the relative value of modern Artillery in the attack and defence cannot be adjudged until more rationally conceived permanent fortifications have undergone a siege.

The operations round Paris are specially instructive, and the attack on the south side may be regarded as typical of the whole. In 1815, Blücher arrived on the heights of Issy and Vanves, and this appears to have determined the positions of the southern lines of forts, although it was pointed out by General Noizet in 1840 that Paris could be bombarded from the plateau of Chatillon with the smooth-

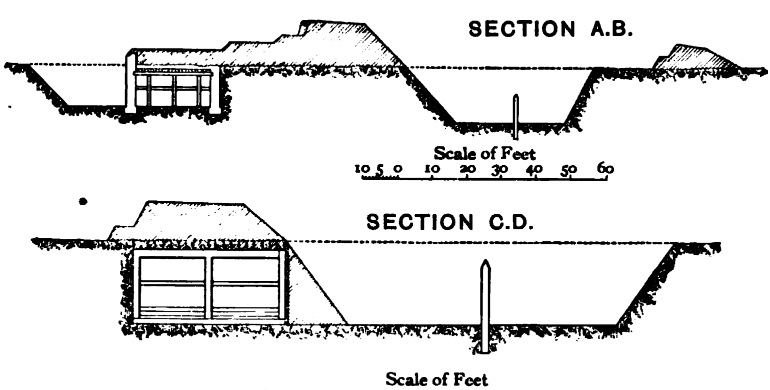
[1] Vinoy.

[2] Three mines were discovered by the Germans in front of Lunette 53, of which one was charged.



DEFENCES OF PARIS (1870). FORT ISSY (PLAN).

N.B —For Sections see Plate VI.



REDOUBT DES HAUTES BRUYÈRES.

N.B.—For Plan see Plate VII.

[To face page 57.

bores of the day. An attempt was made to occupy the plateaus of Chatillon, Clamart, and Meudon by provisional works; but, in the general confusion which followed the defeats on the frontier, these works could not be completed, and were abandoned to the investing army.

Fort Issy (Plate V.) may be regarded as a fair type of the detached forts of Paris. The adjacent works of Vanves and Montrouge were precisely similar in conception, but were based upon a square trace.[1]

Issy, which must be supposed to represent the ideal of the dominant school of thought in France in 1840, thoroughly illustrates the practical outcome of pure theory. One school had desired to surround Paris with a stupendous bastioned *enceinte* wandering over hill and dale, ignoring topography and the elementary principles of tactics alike. This scheme, however, appearing either too evidently preposterous, or more probably too expensive, for practical realization, the detached forts won the day. The result is a curious study. Deprived of half the fascinating possibilities of the Vauban era, the French engineers of this period appear to have conceived nothing more original than to take a purely geometrical form and apply a bastioned trace to it, adding as many rudimentary organs as possible. Thus the *tennaille* reappears, but covers only a limited portion of the curtain wall of the scarp (see Section *I K*, Plate VI.). The lost ravelin is permanently represented by the excrescence in the covered way, and provisionally reproduced in the palisade enclosure *X*.[2] Even the so-called "*redoubt* of the covered way" has its expression. The work is treated similarly on all the faces, otherwise the symmetry and the

[1] By which the evils of the bastioned system were aggravated. This system, however, found a surviving advocate in Colonel Prévost in 1872.

[2] This appears to be better suited to the purposes of a village pound than to those of Fortification.

general appearance of the design would have been marred; yet it is not easy to understand how Fort Issy could have been attacked by an enemy occupying a position between it and the *enceinte* of Paris. The elaboration accorded to the rear faces was scarcely needed as a protection against parties of Infantry, which might have succeeded in passing between adjacent works, and even smooth-bore field guns once established in rear could easily have trundled their round shot into the dwelling casemates. The revetments were hopelessly exposed, and a siege train of the type employed in 1812 by Wellington at Ciudad Rodrigo, twenty-eight years before Fort Issy was built, would have breached them with ease.

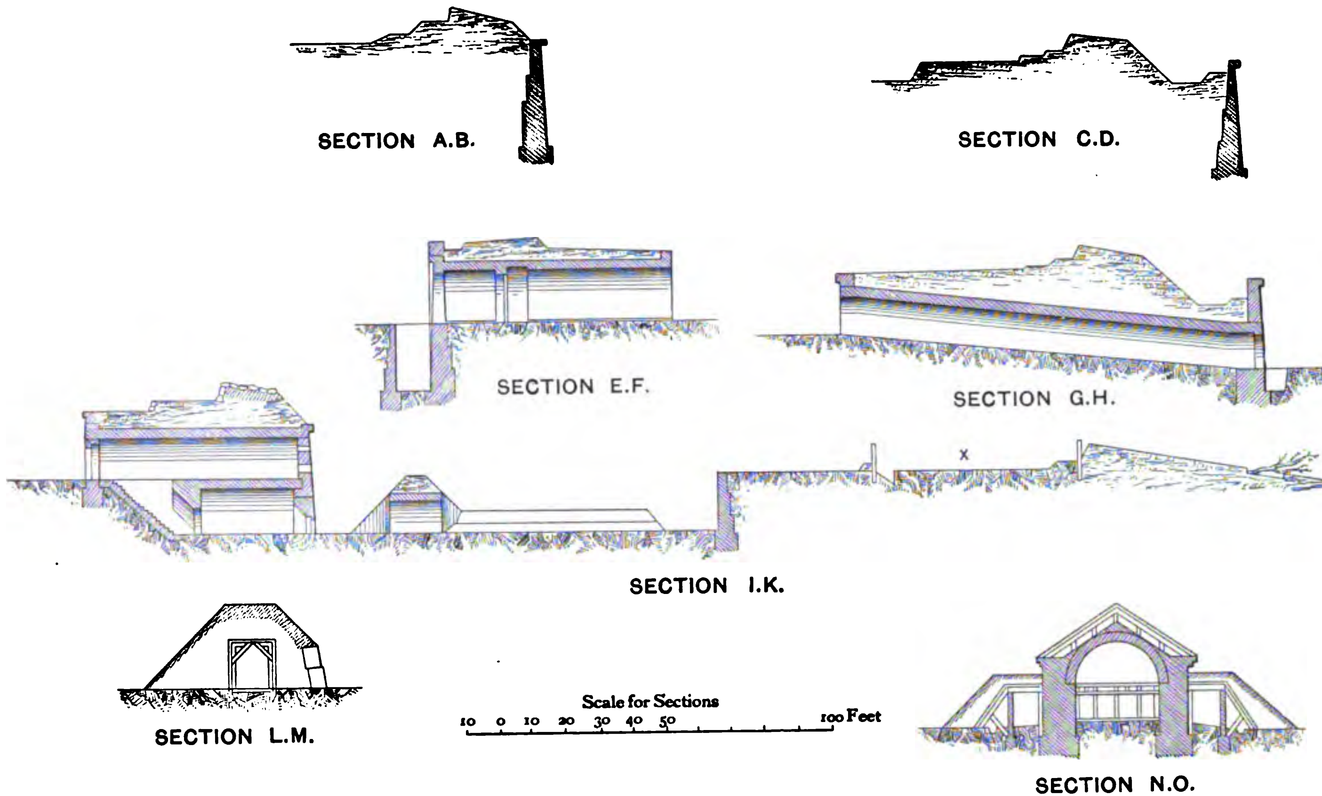
As early as 1824 important experiments were carried out at Woolwich with smooth-bore howitzers and carronades fired at elevations of 10° to 21°, by which a screened wall was successfully breached (see p. 42). To build revetments thus exposed in 1840 was, therefore, doubly inexcusable. The teaching of the past had in fact been forgotten in the fascinations of tricks of trace and detail. The result was a costly work, mounting sixty guns, which may have flanked everything flankable, but were utterly unable to cope with siege batteries, on which only a fraction of them could be brought to bear. Further, the work exposed long faces to enfilade fire,[1] very few traverses having been provided.[2] Rather more than three-fifths of the whole of the enclosing rampart was taken in reverse![3] Such were the conditions created by a subordination of the requirements of war to geometry.

[1] The flanks being so short, two whole fronts were practically liable to be enfiladed each by a single siege battery.

[2] Traverses were subsequently added as shown in Plate V. Among curious relics of the past is the mode of palisading the covered way. See Section *I K*. The futility of this particular measure had been pointed out in Von Moltke's account of the Russo-Turkish War of 1828-29.

[3] The rear faces were, in fact, practically breached by reverse fire.

PLATE VI.



DEFENCES OF PARIS (1870). FORT ISSY (SECTIONS).

N.B.—For Plan see Plate V.

[To face page 58.

Immediately after the Danish campaign, the Germans had adopted the high carriage, and it was against siege guns thus mounted that the ordnance of the forts firing through narrow embrasures, dating back for more than 200 years, and condemned by Morla in 1796, were forced to contend. Thus arose the obvious anomaly that Artillery brought hundreds of miles in winter and placed in rough batteries built in the field was not only far better protected, but secured a much wider field of action than guns mounted in costly forts built with all deliberation in time of peace. In such conditions it is easy to understand that the silencing of the forts was a matter of no great difficulty, and that the "annex batteries," and the works built after the investment, alone gave any real trouble to the attack.[1] The "Park Battery" of Issy, for example, was found particularly difficult to hit, and everywhere guns fortunate enough to be posted *outside* of the expensive positions specially built for their accommodation enjoyed comparative immunity.

The guns of the defence, posted haphazard and served by men in no sense organized for the duty, were evidently unfit to compete on equal terms with a well-appointed siege train; and the want of any clear ideas as to how fortress Artillery should be handled, combined with the indifferent shooting of the French gunners, serves to explain the fact that for about 60,000 rounds fired on the south front, the German loss was 50 killed and 281 wounded, an average of 181 rounds to each man hit.

On the other hand, in spite of many advantages, the Artillery of the attack apparently developed little man-

[1] One mortar battery behind the railway embankment between Forts Issy and Vanves could never be silenced, and the "annex batteries" of Vanves and Montrouge were never more than temporarily held in check. Belagerung von Paris.—Heyde and Froese.

killing power. Vinoy gives the following as the average daily loss in the forts named and their satellite works during the twenty-two days' bombardment—viz.:

Fort Issy	8
Fort Vanves	5
Fort Montrouge	8[1]

The summary of damage caused to these works (Appendix F) serves to illustrate the difference between siege operations and target practice.

If the results due either to initial errors of Fortification or to the superannuation of the forts are subtracted, and if a further correction is made on account of the bad mounting and equally bad handling[2] of the French guns, it will be evident that works well conceived and well fought have little to fear in an Artillery contest.

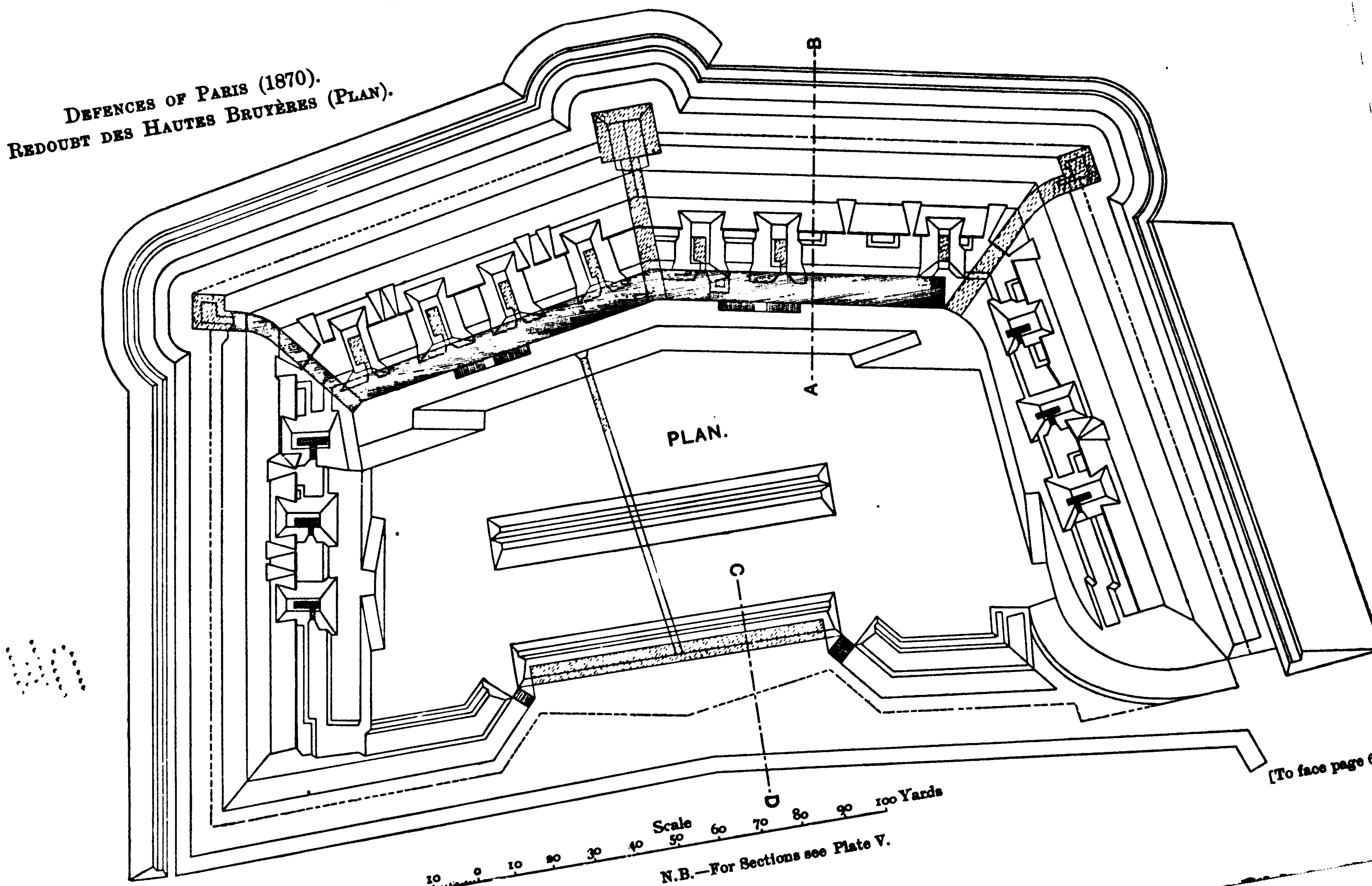
In spite of their innumerable defects, the Paris defences, built before the revolution in Artillery, won an unexpected triumph for Fortification. They answered their purpose in 1870-71, as well as they would have done thirty years previously, and there is little doubt that works could have been executed at about one-fifth the cost, which would have given even better results.

No teaching in regard to assaults is to be gained from Paris. Advantageous as it would have been to the Germans to occupy the line of the southern forts which lay only 2,000 yards from the *enceinte*, no regular attempt was ever made

[1] Admiral de la Roncière gives the total loss in Montrouge as 29 killed and 137 wounded.

[2] There was "an inexcusable waste of ammunition, apparently according to no prearranged plan, and without skilful supervision." "The Garrison Artillery paid not the slightest attention to watching their fire for the purpose of fixing its elevation and direction; similarly they appeared to profit but little by the great advantage they had on their side of being able to ascertain the distances accurately."—Colonel von Tiedemann.

DEFENCES OF PARIS (1870).
REDOUBT DES HAUTES BRUYÈRES (PLAN).



N.B.—For Sections see Plate V.

[To face page 61.

to breach the exposed revetments.[1] The French works were well supplied with obstacles; but the amount of "undefended ground," represented by the profusion of quarries in front, was calculated to unhinge any well-regulated mind.[2]

In strong contrast to the costly permanent works of Paris is the Hautes Bruyères redoubt (Plate VII.), an advanced work on the south-east of Fort Bicêtre. This work, copied from a German design, was begun about the 4th September,[3] and not completed till some time after the investment. It provided safe bomb-proof cover for 500 men crowded, and when surrendered at the capitulation had an intact armament of thirteen guns and two mortars. One bomb-proof only showed signs of injury. The embrasures had all been repaired, and the work generally had received little or no damage.

A continuous *enceinte* of old type was regularly besieged at Strasburg only. The covered way was crowned in due form; descents into the ditch were made; a bridge of casks was built leading to one of the advanced lunettes. Orthodox breaches were effected, and altogether the operations resembled those of the preceding century—even to the surrender previous to assault. The Artillery of the defence

[1] "What it means to attack a fortress which an army lies ready to defend might have been learned from Sebastopol. . . . To bombard Paris, we should first have to hold the forts. Nothing has been omitted towards the employment of this forcible measure; but I look for far greater results from a slower but surer agent—hunger."—Von Moltke to his brother Adolf, Versailles, 22nd December, 1870.

[2] An interesting prehistoric monument, which used to stand in front of the Cottonera Lines at Valetta, has been lost to the archæologist for ever. These few stones might possibly have sheltered four or five men, but in accordance with the high standard of preparation for war maintained in our works of defence, their removal was regarded as a matter of urgency.

[3] Geldern.

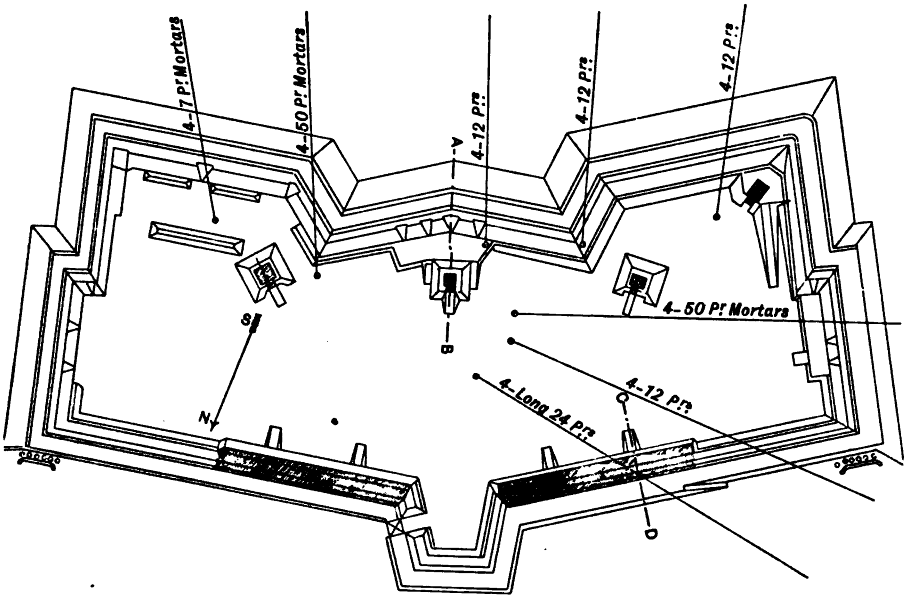
was hopelessly overpowered, and of the total German loss of 866, only 389 casualties were due to Artillery fire.[1] The defenders had ninety-two guns dismounted ; but the mortars, of which little use was made, remained uninjured. The breach in bastion No. 11 could have been defended with little difficulty, and the works generally were still defensible when surrendered. The fall of the fortress was doubtless accelerated by the heavy bombardment of the town and by the insufficiency of casemate cover for the garrison in the vicinity of their lines. Notwithstanding all disadvantages, however, Strasburg, judged by the standards of the past, made a good defence.

The siege of Belfort presents some special points of interest. Belfort possessed the supreme advantage of a commandant who understood the nature of the task which devolved upon him. Moreover, Colonel Denfert, not being invested till the 3rd November, had a long period for preparation, which he was well qualified to utilize. Outside an *enceinte* of most elaborate description[2] there were on the north-east side two permanent forts, La Miotte and La Justice, designed by Haxo ; and on the west, a large work of recent construction, Des Barres. The south side, which was chosen for the attack, was defended by two provisional redoubts—Haute Perche and Basse Perche (Plate VIII.)—and one simple field work, Bellevue, the respective intervals being 700 and 1,700 paces, and the distance from the *enceinte* 1,200 paces.

The villages of Danjoutin and Bavilliers, about 1,500 paces in advance of this line, were held by the French ; but, probably on account of the great amount of other necessary work, were not placed in a satisfactory state of defence. Bavilliers, which was weakly occupied, was surprised by a

[1] Von Brünner.

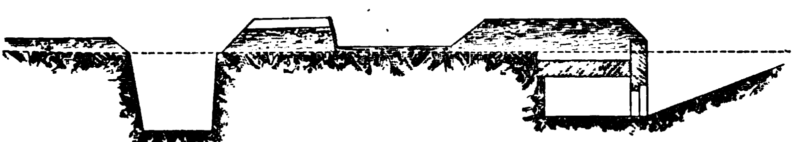
[2] Principally Vauban's third and worst system. See Fig., p. 7.



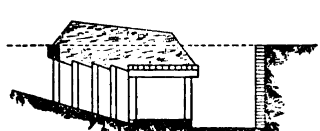
Scale for Plan
10 0 10 20 30 40 50 60 70 80 90 100 Yards

DEFENCES OF BELFORT (1870). REDOUBT BASSE PERCHE (PLAN)

SECTIONS.



SECTION A.B.



SECTION C.D.

Scale for Sections
10 5 0 10 20 30 40 Feet

[To face page 62.

night attack; but Danjoutin repulsed the first assault on the night of the 14th-15th December, and was only captured on the night of the 8th-9th January after a siege-gun bombardment. A systematic attack was then directed against the Perches redoubts, supported by a siege train of 268 guns and mortars, of which ninety-six (including forty long 24-pounders) directed their fire on the Perches and Bellevue, armed each with eight to ten field guns only. The defenders, however, handled their Artillery with remarkable vigour, frequently moving their guns and employing high-angle fire against the siege works. "There were many pressing reasons"[1] for ending the siege, and an assault on the Perches took place on the evening of the 26th January. The right column attacking Haute Perche had the advantage of ground which "screened it from the defenders' view during the greater portion of the advance; but beyond this point it was checked by the heavy fire of the enemy."[2] The men of the left column directed on Basse Perche (Plate VIII.) succeeded in descending into the ditch, where they were caught by French reserves, and nearly all captured or killed.

"The assault, therefore, completely failed," and the saps were pressed on to the ditches. On the 8th February, the Haute Perche was surprised by the Germans, who found only a guard of ten men ensconced in the gorge bomb-proof. The Basse Perche was captured almost at the same moment after slight resistance. The heights thus occupied were rapidly turned into a formidable Artillery position for sixty guns, and the *enceinte* and citadel would have quickly fallen if the armistice had not supervened.[3] Belfort, on the front

[1] Colonel von Tiedemann.

[2] Colonel von Tiedemann. This repulse has been attributed to a rough entanglement formed between the stumps of the trees cut down (Geldern). There were no other obstacles.

[3] "The place was no longer tenable."—Von Moltke.

attacked, thus presents the case of a stupendous *enceinte* protected by provisional works. The latter answered their purpose remarkably well; the former, *quâ enceinte*, could not have held out after the provisional works had fallen. The design of the Perches redoubts possesses no merit of any kind; but the steep rock-cut ditches proved an efficient obstacle. The trace is only interesting from the Darwinian point of view, the little one-gun projections in the flanks being specially remarkable.

While, however, Belfort made a good defence, it must not be forgotten that the difficulties of the besiegers were great. Their position was threatened by Bourbaki's army till after the fighting on the Lisaine. The ground was rocky and frozen, which made the siege works hard to carry out. Much sickness appeared among the troops. *Per contra* the nature and state of the ground was equally disadvantageous to the defence, and on the 3rd December the commandant was called upon to deal with a partial insurrection in the city. Moreover, Colonel Denfert had only 2,600 regular Infantry and 11,700 *gardes mobiles*, who at first lacked training and discipline.

The teaching of the siege operations of the 1870-71 campaign may be briefly summed up as follows:

1. The introduction of rifled weapons did not effect a diminution of the resisting power of fortresses designed to oppose smooth-bores.

2. The real successes of the siege Artillery were obtained against civil buildings, and properly designed works have little to fear from its effects. In most cases, smooth-bore guns would have been able to deliver an equal number of projectiles into the towns, and the greater effect of the modern weapons was due to increased shell-power and accuracy, not to range.

3. The earlier methods of mounting fortress guns proved

hopelessly obsolete—a fact which the adoption of the high siege carriage by the Germans in 1865 might have rendered sufficiently evident.

4. The handling of the Artillery of the defence was almost uniformly faulty, and no satisfactory conception of its powers can be formed until the proper employment of this arm is understood, and the organization necessary for the full development of its action has been applied to war.

5. The French fortresses were, almost without exception, defended by the rifle alone.

6. The siege of Paris serves, as pointed out in 1874,[1] to kill reduits.

7. None of the superfluous technicalities with which the heads of cadets were, at this period and later, uselessly crammed, and by which an erroneous conception of Fortification was impressed upon them, proved to have the smallest value.

8. Within broad limits, the nature of the works of a fortress is subordinate to tactical conditions, and the conduct of a defence, the degree of preparation for war, with other matters which theory is apt to ignore, must mainly determine the issue of siege operations.

9. The low command and comparative invisibility of the works constructed at Paris after the investment gave them great advantages over the permanent forts.[2]

[1] Belagerung von Paris. Heyde and Froese. No such happy result followed, however. *Vide* " La Fortification du Temps Présent," 1885.

[2] Von Tiedemann mentions the attempt made to conceal the siege batteries before Longwy. " A peculiar method of construction was adopted to obtain more cover and to reduce the chances of discovery, and this consisted in making the flanks with gentle slopes which could scarcely be discovered at a distance." Similar measures had been previously adopted at the siege of Fort Wagner, where " great care was taken not to disturb any of the natural features of the landscape."—Gillmore.

CHAPTER VII

PLEVNA—KARS (1877)—WORKS CONSTRUCTED IN ENGLAND AFTER 1859—GENERAL REVIEW

PLEVNA, when Osman Pasha's advanced guard from Widdin arrived there about the 16th July, 1877, was an open Bulgarian village lying in a hollow with rolling hills around it. Nicopolis having been taken on the 14th, Schilder-Schuldner with between 8,000 and 9,000 men and forty-six guns was ordered to occupy Plevna, then defended by a few trenches only. The position was attacked on the 20th, and part of the force reached the outskirts of the village, only to be defeated with a loss of about 2,900—more than one-third of its strength. From this day the strength of the place steadily grew, and when attacked on the 30th July by Krudener and Schackoffskoi with about 30,000 men and 176 guns, the defences were by no means to be despised. The complete failure of this second assault with a loss of about 7,300—one-fourth of the attacking force—changed for the time the whole aspect of the campaign, and rendered the position of the Russian army in Bulgaria temporarily precarious. The Roumanian contingent having been brought across the Danube, and Russian reinforcements having arrived, the total force before Plevna reached a strength of about 75,000 Infantry, with 9,500 Cavalry, 364 field guns, and 24 siege guns. On the 11th September, a general assault was delivered, preceded by a three days' bombardment, but was

repulsed with a loss of about 17,500, amounting to 31 per cent. of the troops engaged, and 23 per cent. of the total strength before Plevna. No. 1 Grivitza redoubt alone remained in the hands of the Allies. On the 18th July, the Roumanians made an attempt on No. 2 Grivitza redoubt (Plate IX.), which was repulsed with a loss of about 400 men.

On the 28th September, Todleben arrived, and a systematic investment was resolved upon. By the 24th October the communications of Plevna were completely cut, and the capture of Telische by Gourko on the 28th swept away the last Turkish force on the Plevna-Orchanié line, and enabled the Russians to close in upon Plevna on the west side. On the 16th November, Gourko started for Orchanié, and the investing force remaining before Plevna consisted of 5,000 Cavalry, 107,000 Infantry, 40 siege guns, and 510 field guns.[1] During the investment the Roumanians carried on a systematic attack (Plate X.) against No. 2 Grivitza redoubt, and on the 19th October delivered two assaults, their trenches being then within about thirty yards of the ditch. These assaults were repulsed with a loss of over 900 men.

On the Green Hills, Skobeleff seized and entrenched a position within a short distance of the Turkish works. With the above exceptions, the operations were limited to a close blockade, varied only by occasional Artillery fire upon the Turkish works. The Russo-Roumanian forces entrenched themselves strongly round the place and awaited the end.

On the 10th December, Osman Pasha, whose resources of food and ammunition were nearly exhausted, made a gallant but hopeless attempt to cut his way out to the West, and Plevna fell after a resistance of 142 days.

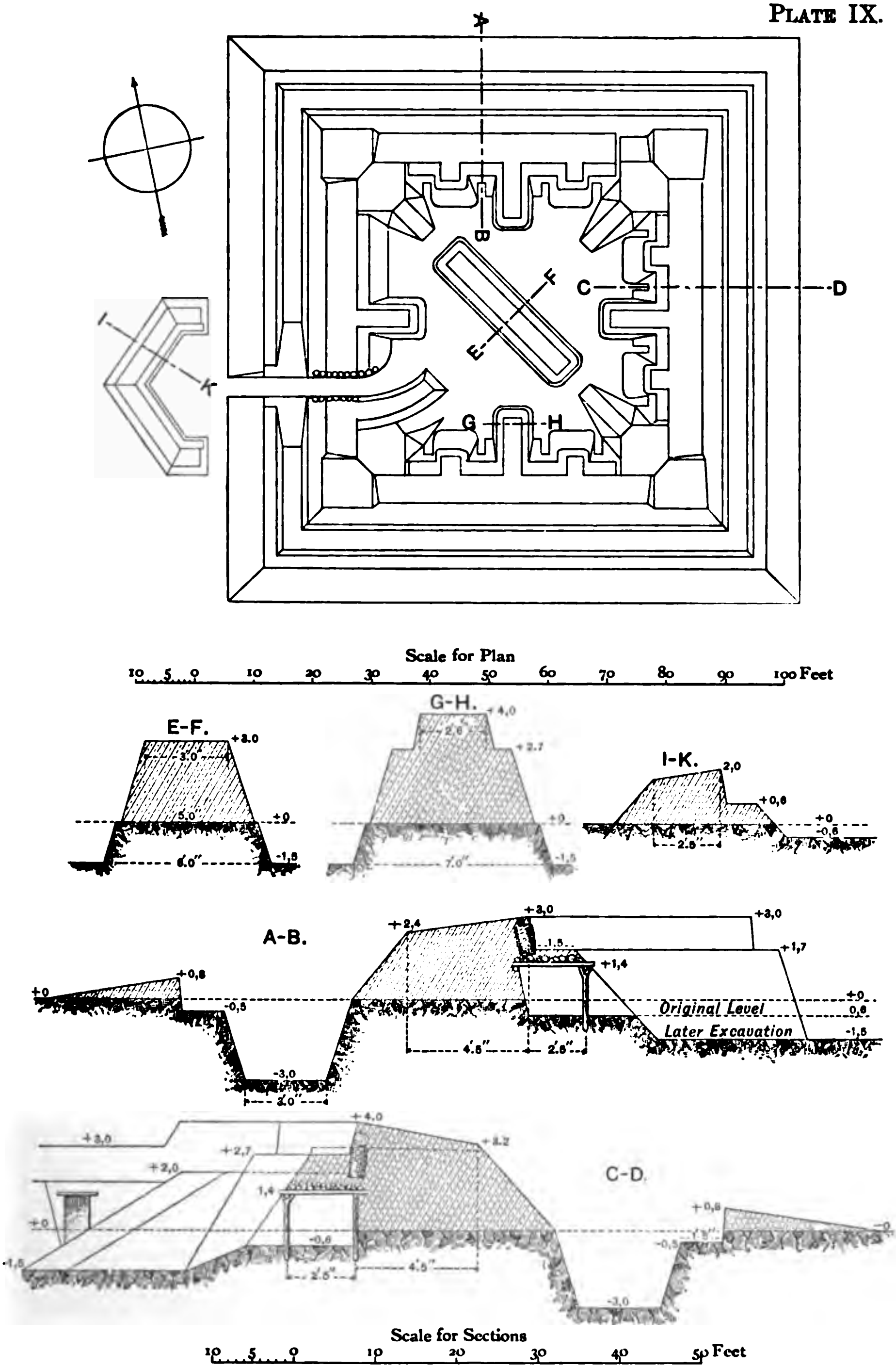
Thus, like Sebastopol, Plevna grew into a fortress under

[1] Todleben.

the eyes of the besieging force; but the two cases present numerous points of difference. At Sebastopol, the line held by the Russians, about 4½ miles in length, was very short in comparison with their numerical strength. Their resources were enormous, and in the number of their guns they always possessed a superiority. On the other hand, the Allies in 1854 brought up an immense siege train as compared with the forty siege guns employed at Plevna. From the first bombardment of the 17th October, the combatants were always face to face, and no such withdrawal of the besieging force took place as occurred at Plevna after the failure of the attack of the 30th July. Again, the communications of Sebastopol, although practically inferior to those of the Allies, remained open till the last. Plevna was isolated after the 24th October. Finally, the soil round Plevna was extremely favourable to trench work on both sides. At Sebastopol, as at Kars, the natural difficulties were great.

Thus, although the conduct of the operations and the results from the point of view of Fortification bore strong points of resemblance, no direct comparison is possible. We, sitting here at home, can demonstrate to our own satisfaction how easily Sebastopol and Plevna might have been taken under arrangements which we are ready to detail; but the fact remains that, under very different conditions, these two extemporized fortresses served the general purpose of Fortification, as the costly ideals of the drawing office have almost uniformly failed to do.

There was no magic about the Plevna redoubts, and no special excellence of design; but the Turks, probably because they were not hampered by theoretical considerations, grasped and applied some great principles, winning corresponding advantages. Plate IX. shows No. 2 Grivitza redoubt, which may be regarded as fairly typical. The



DEFENCES OF PLEVNA (1877). No. 2 GRIVITZA REDOUBT.

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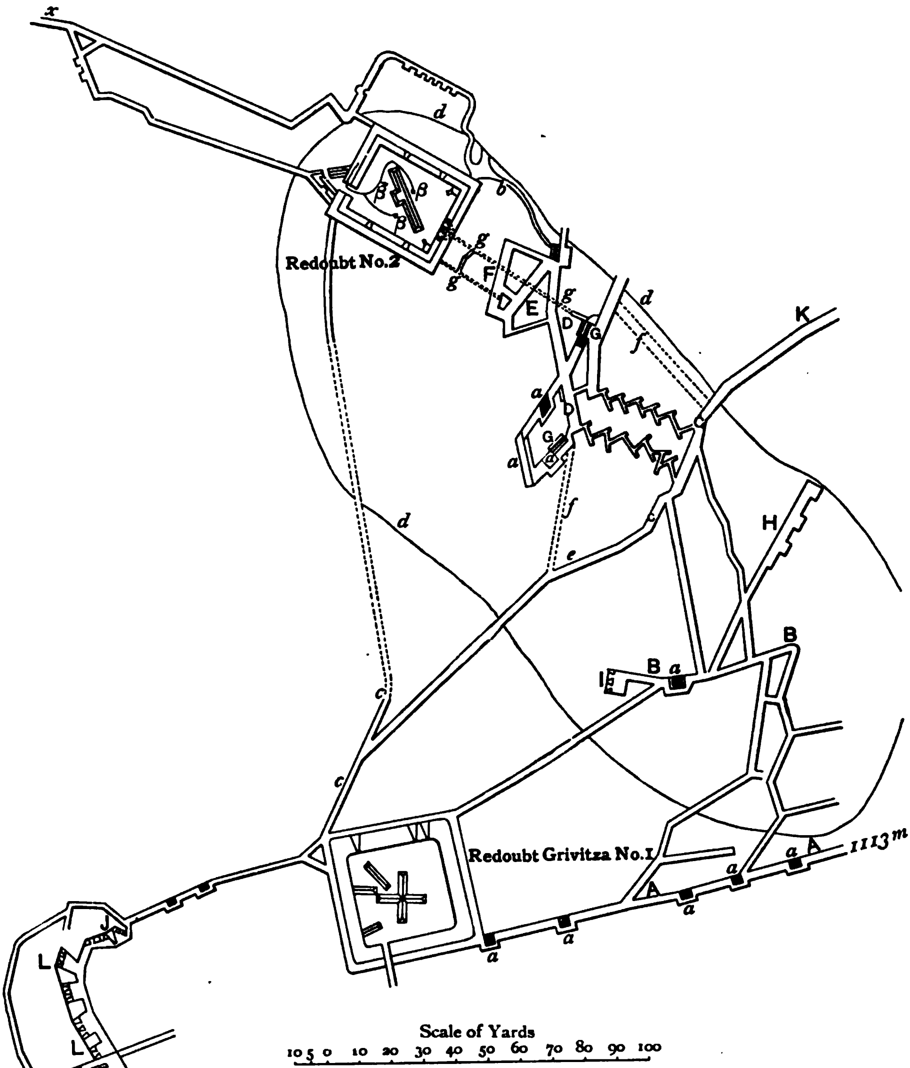


Defences of Plevna (1877).

Roumanian Attack on No. 2 Grivitza Redoubt.

AA. First Parallel.
BB. Second Parallel.
CC. Third Parallel.
DD. Fourth Parallel.
E. Fifth Parallel.
F. Sixth Parallel.
GG. Trench Cavaliers.
H. Mortar Battery.

I. Battery against the town.
J. Battery against Bucova.
K. Junction with the parallel of the Third Division.
LL. Batteries.
aa. Traverses.
bb. Turkish trench.
cc. Old Turkish covered way between the redoubts.

dd. Brow of hill.
e. Trench.
ff. Trenches in course of construction.
gg. Mine galleries.
x. Covered way leading to Turkish works of Bucova.
ββ. Fougasses.

[To face page 69.

existence of this little work was not known at the time of the great assault of the 11th September; because it was effectually masked by maize, which ought to have been cut down so as to give a free field of fire for whatever number of yards the text-books may agree to lay down. The result of this neglect to "clear the foreground" was that the 3rd Roumanian Division, told off to assault No. 1 redoubt from the north, after making its way with difficulty up a steep slope covered with brushwood, came unexpectedly upon No. 2, and was repulsed with heavy loss. Further, the capture of No. 1 redoubt, the so-called key of the position, at an immense sacrifice of life, proved practically valueless.

Against the little No. 2 Grivitza redoubt on a square of forty-six yards side and commanded at 300 yards by No. 1 redoubt, an elaborate formal attack was carried on (Plate X.), ending in the establishment of mines under the parapet. These operations may appear at first sight necessarily superfluous, but that similar instances are recorded even before the era of the breech-loading rifle. At Cassel in 1762, a little earthwork was regularly besieged, and at Colberg in 1807 a small detached field redoubt made a resistance of forty-four days. In 1870, the Perches redoubts at Belfort were honoured by systematic approach (p. 63).

The Plevna works are easy to criticise. The square trace, almost universally adopted, gives large "dead angles." "Undefended space" existed to a surprising extent. The relative traces of adjacent works were often guiltless of any mutually flanking purpose. One important group of works was completely commanded by a ridge which appeared to tower over it. The ditches had no flank defence of any kind. "Every (provisional) fort should be provided with a keep," said one of our text-books.[1] No work at Plevna

[1] Written some time after the siege of Paris, which in the opinion of other authorities (Heyde and Froese) sufficed to kill the reduit.

had anything of the sort ; nor was there room for it. While, however, in these and other respects, the Plevna defences were theoretically deficient, the Turks appear to have fully realized certain principles of far greater importance in war.

Plevna was to be defended with the rifle mainly, and scope must therefore be allowed for its use.[1] A long line of defence had to be held. Closed redoubts on the tactical points, supplemented by numerous light trenches on front and flanks, met the case, providing for a great development of rifle fire ; while, at the same time, the temporary loss of portions of these trenches mattered little. The Russians had an immense superiority in Artillery, and would be able to render the manning of the redoubts scarcely practicable under fire. The garrisons must therefore be close at hand and able to occupy their stations at short notice. This condition was fulfilled, not only by liberally providing cover in the works themselves (*see* Plate IX.), but by locating them in some cases so that the ground fell immediately in rear, thus greatly facilitating the protection of the reserves. This tendency to draw back the works from the positions in which we are accustomed to place them was based on a correct instinct. With an excellent breech-loader and plenty of ammunition, the distance required to repulse an assault is comparatively short.

The principal defect of the Plevna defences was the complete absence of all obstacles, for the construction of which there was no suitable material at hand. The sides of the

[1] In an elaborate design for a large permanent fort, the cost of which would be at least £60,000, the two front faces have 42 yards of infantry parapet, and there is no covered way. The front face of No. 1 Grivitza redoubt provided 32 yards, and the covered way 85 yards more. As regards frontal development of rifle fire at long range, therefore, the little work thrown up in the field far surpassed the costly permanent fort. At close quarters, the advantage would be only four to three in favour of the latter.

ditches stood at steep slopes; but the degradation of the parapet under the heavy Artillery fire to which the works were subjected somewhat facilitated assault. The addition of good obstacles would not only have saved No. 1 Grivitza redoubt from capture, but may fairly be set off against the tactical errors committed by the Russians.

Plevna, like Sebastopol, supplies no argument against permanent works built in peace-time; but, in common with all the experience of war, it distinctly proves that the Fortification which has been arrived at in defiance of the law of the survival of the fittest[1] may be safely relegated to the domain of abstract speculation.

While Tewfik's extemporized place of arms was holding the Russians completely at bay in Bulgaria, the far more ambitious fortress of Kars fell into their hands for the third time. Kars, taken in three days in 1828, was only starved into surrender in 1855, after a splendid resistance of five months, during which heavy losses were inflicted on the besiegers. Permanent defences having been added, the fortress was stormed on the night of the 17-18th November, 1877, with a loss of 2,273 all told, having made a resistance of about thirty days. On the 15th October, Moukhtar Pasha's army had been routed on the Aladja Dagh, "nearly half of it being destroyed."[2] Moukhtar himself reached Kars during the night of the 15th-16th October "in the midst of the disorganized, panic-stricken fugitives." "Taking 2,800 men who were in a reasonable state of organization," he abandoned Kars to its fate. The fortress had twelve detached forts and a citadel, nearly all built after the Crimean War. The weight of the assault fell

[1] The evolution of Fortification appears to have proceeded under an arbitrary and artificial selection akin to that which has given to us the pug dog and the lop-eared rabbit.

[2] "Russian Army and its Campaigns."—Greene.

upon three works in the plain to the south-east of the town—Hafiz, Kanly, and Souvari. Hafiz was a square redoubt on a side of 400 yards with bastions at the angles, traversed parapet, ditch twelve feet broad and six feet deep, with a three-storied casemated barrack at the gorge. Kanly consisted of two square redoubts on a side of 150 yards, with a lunette in rear, having bastioned faces and a two-storied casemated barrack closing the gorge. Souvari was a simple lunette, and, in common with several of the remaining works, had no ditch. The works generally had no secure casemate cover and no water-supply; Hafiz and Kanly alone had traverses, and earth for repairs was not available.

Kars was invested shortly after the battle on the Aladja Dagh, and a bombardment from forty-eight siege guns was opened on the 11th November. The results appearing to be small, it was determined to assault. A moonlight night was chosen in order to surprise the garrison, and at the same time avoid the ample chances of disaster which operations undertaken in the dark necessarily involve. The Turks appear to have been entirely unaware of impending danger. Fort Souvari was completely surprised, and captured without firing a shot. The two columns of ten battalions told off to attack Fort Kanly were checked under fire by some *trous de loup* in front. The eastern redoubt was, however, stormed and the western redoubt turned without much difficulty; but the work in rear offered considerable resistance. The reserves were brought up and both flanks were turned, a portion of the garrison still holding out in the casemated barrack till threatened with dynamite. In front of Fort Hafiz also the attacking force of five battalions was discovered before it could close, and about 2,500 men swerved to the right to attack some trenches on the Kara-dagh. Hafiz was ultimately assaulted in front simultane-

ously with a flank attack from Fort Kanly, and was carried. The Turks endeavoured to shelter themselves behind the casemated barrack which had been ruined by the Russian Artillery fire, but were caught, and "annihilated."[1] Fort Karadagh was an earth bank laid out on the bare rock with a bastioned trace in front. There were neither ditches nor traverses, and the barracks with which the gorge was to have been closed were unfinished. There was, however, an interior cavalier forming a species of keep. The Russian force diverted from the attack on Fort Hafiz succeeded in entering Fort Karadagh, and followed the Turks into their interior work. The loss of the four forts above named sufficed to procure the surrender of the citadel and all the works on the left bank of the Kars River.

While, however, the Russians achieved an almost unbroken success on the right bank, the assault of Fort Tchim and an unpremeditated attack on Fort Tekmass resulted in complete failure. Fort Tchim, the nearest work to Souvari, on the other side of the river, a lunette with a closed gorge, but without ditches or traverses, was surprised and attacked in rear by the three battalions which had captured Souvari; but the Russians were repulsed. A little later an independent attack was delivered in front by one battalion, which did not even succeed in reaching the work. Fort Tekmass, a weak edition of Fort Kanly, having no outworks or casemate barracks, was attacked by three battalions, who were so much cut up as to be "practically of no more use during the night."

Kars in 1877 clearly made a poor defence, although the respective strengths of the garrison and of the attacking force were curiously similar to those of the combatants of 1855 (see pp. 36, 37). Though faulty in many respects, the defences in 1877 were of a much higher technical order than

[1] Report of Grand Duke Michael.

Colonel Lake's works, mainly built of piled-up stones collected after the arrival of the besiegers. Moreover, cholera had not appeared in Hussein Pasha's camp. There is little to learn from the third siege of Kars, which, however, furnished further proof of the small influence of the so-called technical qualities of Fortification in comparison with general tactical conditions. You cannot make an indifferent and badly handled force safe with all your money and art. Given a sufficiency of supplies and ammunition, any rationally conceived defences are sufficient for the purpose of steady troops ably commanded.

The barrack in the gorge of Fort Kanly which appears to have accidentally escaped destruction by the Russian Artillery fire, to which it was fully exposed, proved a godsend to the advocates of keeps, reduits, citadels, etc. The late General Brialmont[1] welcomed this "*exemple remarquable de l'utilité des reduits*" as a support to an excessively thin argument in which the entire question was begged at an intermediate stage by the assumption that keeps "double the moral force of the garrison," and allow its strength to be diminished. The case of Fort Kanly simply shows that, if a redoubt presents no obstacle whatever to assault, and can in addition be turned without difficulty, an intact loopholed building will afford a temporary refuge to such of the defenders as can manage to escape into it—more than 500 Turks were killed in the outside work. This must have been a sufficiently evident proposition at all periods; but the further step—the acceptance of the reduits proposed by General Brialmont, which are inside a deep and over-flanked ditch, and which, moreover, would be practically valueless if the real line of defence had fallen—does not follow therefrom.

The works constructed in England after 1859 were

[1] "La Fortification du Temps Présent."

specially favoured by circumstances, as was pointed out by Lieutenant-Colonel (the late Lieutenant-General Sir T. L.) Gallwey, R.E.: "We as a nation may consider ourselves fortunate that the defence of our principal ports has been postponed to the present time." With few exceptions, these works were constructed after rifled ordnance had unmistakably proved its powers. The evidence given before the Royal Commission which reported on the 7th February, 1860, is conclusive on this point, and the certain supercession of smooth-bore guns was thoroughly recognised by all the most competent witnesses. Thus, Captain Hewlett, R.N., stated: "I need not say how important it is that Armstrong's guns should be substituted as soon as possible for the common ones in the defence of our arsenals." General Sir J. Burgoyne spoke of "five-mile weapons," and added, "Not only Armstrong's, but any rifled gun will do the same thing." Sir W. Armstrong testified: "The extreme range I have reached is 9,175 yards; at a distance of 8,000 yards I think that an object occupying an area of ground 100 yards by 50 yards width would receive about one-third of the shells fired at it from land batteries;" and he further expressed the opinion that "it would be very unsafe to presume that guns of equal power may not be brought against us during the next two or three years." As regards high-angle fire, Sir W. Armstrong was equally clear that rifled ordnance would entirely supersede smooth-bore mortars, and he informed the Commission that he had obtained the "greatest results at 35 degrees," significantly remarking: "that you can strike a wall . . . firing with low charges at a rapidly descending angle, is certain."

Similarly, the Committee, of which H.R.H. the late Duke of Cambridge was president, reported on the 22nd February, 1859, that the guns of the day, "even at their present ranges (and there is every prospect of their being further increased),

will require that an enemy be kept at a distance of 9,000 yards." Obviously, therefore, any notion that the danger of long-range bombardment to fortresses is the direct result of the introduction of long breech-loading guns is entirely fallacious. The danger existed and was completely foreseen many years previously.

The conditions under which the greater part of the defences of England and of the four Imperial fortresses abroad were designed were thus far more favourable than those which faced the projectors of the Paris forts of 1840. A revolution in arms had already taken place, and the best minds of the day had fully grasped its portents. A further advantage existed in the rich experience gained at a heavy cost in the Crimea, which had made a profound impression on all who were able to grasp its meaning.

A detailed examination of the designs of the works in question with a view to ascertain how far they conformed to the conditions of the day, and how far mere theory was permitted to override the teaching of war, though specially instructive from the present standpoint, would be manifestly inexpedient. The works were large, elaborate, and costly. The bastioned trace to which the French engineers had clung with so much wasted affection was happily superseded, its place being taken by caponiers, occasionally of monumental proportions. The single line of fire of the flank was replaced by two or three tiers in the caponiers. The high scarps with the disadvantages subsequently demonstrated were retained; notwithstanding that Sir W. Armstrong's evidence, taken in conjunction with the results obtained in the experiments carried out with smooth-bore ordnance at Woolwich sixteen years previously, and with light rifled guns at Juliers in 1860, supplied a strong argument for the Carnot detached wall. Theory decided that the latter provided special facilities for escalade—a delusion

which experiment would have dispelled.[1] The result was in some cases a revetment barely able to sustain its normal load. The principal characteristics of these works are large size, high command, broad and deep ditches, tall caponiers. The trace is fairly simple, though the interior arrangements are sometimes complicated. There are keeps in some cases, and two-storied casemate barracks are to be found. Unlike the Paris forts of 1840, the gorges are specially treated. It was considered that only Infantry would be able to penetrate between adjacent works, and thus, concurrently with a gorge provided with a deep ditch, a three-storied caponier, and a drawbridge, might be found a main magazine offering a 3 feet 6 inches vertical wall to any projectile arriving with a fall of two or three degrees. The dwelling casemates being similarly exposed, it is clear that the works were regarded as unassailable in rear by Artillery fire, or by long-range Infantry fire, even in the absence of an *enceinte*. Taken as a whole, the guiding principle of these works seems to have been to provide large enclosures secure against assault—so long as they were not subjected to the fire of siege guns. The measure of such security reached the highest standard which the most exacting theory would be

[1] The only comparative experiment to which the writer is able to refer is recorded by Von Brünner.

1. *Scarp* 30 *feet high, counterscarp* 22 *feet high.*

The time, from the arrival of the escalading party at the top of the counterscarp to the moment when twenty men had climbed the parapet, was 8½ minutes.

2. *Detached wall* 20 *feet high, counterscarp* 17 *feet high.*

Time, also 8½ minutes.

Assuming parallel conditions to have been secured, the detached wall proved to be the best physical obstacle, for it was little over half the height of the competing scarp, and was combined with a counterscarp 5 feet lower.

The increase of the obstacle to escalade secured by the adoption of the detached wall was afterwards recognised in our text-books.

likely to demand; but this ideal was only attained by an expenditure so heavy as to cause a reaction which prevented the defences themselves from being properly completed. In matters of Fortification the experience of war sometimes reverses the order of importance which theory prescribes, and a parapet composed mainly of large, hard, and sharp stones would prove to be a greater practical disadvantage than a caponier of only one story, or even the absence of a drawbridge.

Reviewing the development of Fortification as dealt with thus far, it appears impossible to escape the inference that the teaching of war had been too frequently neglected, and that bare theory was permitted to run rampant. The best Fortification, judged by results, has been that improvised by stress of circumstance, unspoiled by the debasing influence of the text-book, and not demoralized by the technical possibilities opened out by large expenditure. In the works constructed after 1860 at our home ports and fortresses abroad, no sufficient indication of the results of the experience obtained in the Peninsula, the Crimea, and the American Civil War, can be traced. Some of these works might have been designed by clever cadets, quick to recognise the niceties of technical artifice, but unable, from sheer immaturity of thought and want of study, to grasp the broader aspects of the science in its relation to war. It is nevertheless evident that the rich and varied war experience available was fully appreciated by many minds, and that but for the want of all real organization of scientific thought, the progress of Fortification would have been more wisely ordered.

Illustrations of the way in which the science lagged behind its leaders could be multiplied indefinitely. To take one simple specific instance; as has been pointed out above, the embrasure was roundly condemned in 1796. In 1839

Smola[1] pointed out that high carriages were essential. In the judgment of the Prussians, Düppel killed the low carriage and embrasure for siege batteries; *a fortiori*, both ceased at the same time to be applicable to the front faces of land works, and Colonel (the late Field-Marshal Sir L.) Simmons stated in 1865: "I think it is very doubtful if we should use embrasures at all."[2] The siege of Paris might surely have served to remove any lingering doubts on the subject; yet, more than three years later, haxo-casemates, infinitely more objectionable than embrasures, were being erected on the front faces of a land work, and the same anachronism was perpetrated even as late as 1883.

Precisely similar evidence is forthcoming in relation to coast batteries. Sir J. Jones significantly recorded the experience obtained in the naval attack on the Castle of Scylla in 1806, where it was "altogether surprising to observe the mischief which had been produced by shot which had deflected from the cheeks of the embrasures and entered the casemates."[3] Sir J. Burgoyne, in a paper written in 1849, stated: "Among the inconveniences apprehended to coast batteries are the openings of embrasures in masonry by which shot that would otherwise have turned without injury . . . are deflected on to the gun and into the battery."[4] This principle, so clearly recognised, was widely ignored. Thus, for example, splayed vertical walls 10 feet high were introduced in Fort San Leonardo at Malta, effectually neutralizing the value of the guns there mounted, and aptly illustrating the divorce between theoretical Fortification and the teaching of war.[5]

Again, before the Crimean War, Sir H. Jones wrote: "It

[1] "Handbook for *k.k. Artillerie Offiziere.*"
[2] R.E. Professional Papers, vol. xiv.
[3] "Peninsular Sieges."
[4] "Coast Batteries." R.E. Professional Papers, 1849-50.
[5] These atrocities have since disappeared.

becomes the duty of the engineer charged with the defences of a maritime fortress so to arrange his batteries that the defence may be from several points distant from each other . . . on commanding situations, and not *a fleur d'eau*, which has heretofore generally been the case . . . for the principal defence, height must be attained."[1] Sir J. Burgoyne, at nearly the same period, held that "the best disposition for guns against shipping is to disperse them very much."[2] The experience of Sebastopol fully bore out the above views, and Todleben enforced the lesson with the weight of his great authority, supported by the results obtained by the fire of the Telegraph and Wasp batteries. This plain teaching was almost completely ignored in this country.

Sure and certain progress in Fortification can be attained only by a careful study of the war experience of the past, combined with the indefinable faculty which can grasp, retain, and apply great principles without being either swayed by the spurious authority attaching to formulas oft repeated, or led astray by the will-of-the-wisp lights of coloured instances.

[1] "Peninsular Sieges." Editor's note.

[2] "Coast Batteries." R.E. Professional Papers, 1849-50.

CHAPTER VIII

SUMMARY OF MODERN PROPOSALS—LIEUTENANT-COLONEL SCHUMANN—GENERAL VON SAUER—GENERAL SCHOTT —M. MOUGIN—LIEUTENANT-COLONEL VOORDUIN—"UN PIONNIER"—GENERAL BRIALMONT—CUPOLAS

RECENT years have produced few new proposals in regard to the design of permanent land defences, and since the completion of the defences of the Meuse and of Bucharest, which were in progress when the first edition of this book appeared, there have been no striking developments of fresh construction. While refraining from building new works on a large scale, most Powers have, wholly or in part, revised their armaments in accordance with modern standards, and the strengthening of existing forts by the addition of masses of concrete has been carried out in many cases.

The following general ideas arose in consequence of the increase of the power of Artillery and the introduction of high explosive shells, from which great results were expected.

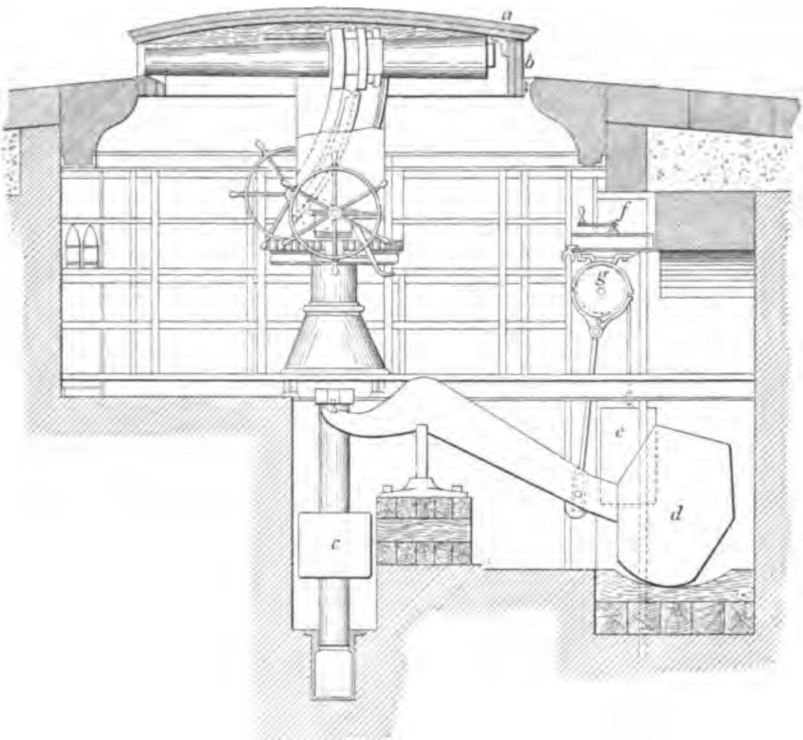
Thus the late Lieutenant-Colonel Schumann, of the Prussian Engineers, the designer of many of the structures made by the Grüson firm at Buckau, held that "armour-plated Fortification is really advantageous only when it is applied without stint. If combined with defence *à ciel ouvert* the advantages diminish"—a proposition which is unexceptionable from the manufacturer's point of view. The armour

was not intended to be applied to forts of the conventional type, since it was desired "*deployer toute la vigueur de la défense sur une ligne simple de coupoles cuirassés.*" The 12-cm. gun (Plate XI.) was adopted as being the heaviest type capable of being mounted in a disappearing cupola. Each gun was to be supplemented by two 12-cm. (or 15-cm.) mortars, also clothed in armour. In some cases the 21-cm. mortar would be employed (Plate XII.). The close defence was provided for by quick-firing guns, partly 53 mm. in disappearing cupolas (Plate XIII.), and partly 37 mm. on "travelling shield mountings" (Plate XIV.).

Plate XV. shows a typical Schumann battery.[1] The trace is an arc of a circle, along which are distributed six 53-mm. quick-firing guns (*b*, *b* . . .) mounted in disappearing cupolas (Plate XIII.). Between the cupolas are small shelters for the gun detachments, as shown in the section EF. In front is a parapet *en glacis* and an *abatis* (*see* section AB). On the flanks are wings, each mounting seven 37-mm. quick-firing guns on travelling shield mountings. At *a* is a disappearing cupola containing one 12-cm. gun (Plate XI.), and close in rear of this cupola are two mortars, mounted as shown in Plate XII. In an advanced position in front of the battery are seven additional 37-mm. quick-firing guns mounted in the same way as those on the wing parapets.

The several modes of mounting the armament are shown in Plates XI. to XIV. The 12-cm. gun (Plate XI.) is placed in a cupola, which, when raised to the firing position, just allows the muzzle to clear the parapet. When the cupola is eclipsed the turtle-back shield SS closes the opening at the top, like a valve upon its seating. An arrangement of levers and counterpoises allows the cupola to be raised and lowered at will. There are no means of laying the gun except by directions received from an observing station

[1] Taken from "Les Affûts Cuirassés."—Julius von Schütz.



Scale $\frac{1}{40}$

12" 6" 0 1 2 3 4 5 6 7 8 9 10 Feet

DISAPPEARING CUPOLA FOR ONE 12-CM. GUN.

(SCHUMANN.)

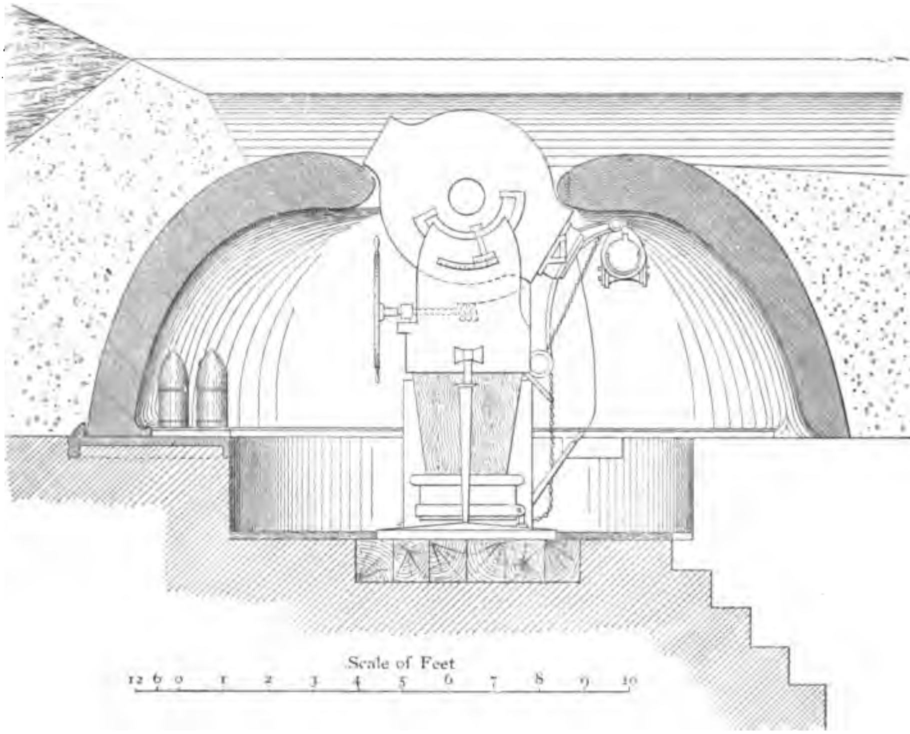
Thickness of roof in two plates (*a*), each 2·36-inch W.I.
Thickness of sides (*b*), 3·9-inch steel.
Total weight with glacis plates, about 52 tons.

DETAILS OF GUN, ETC.

Length, 22·4 calibres.
Weight, 22½ cwt.
Maximum elevation, 25 degrees.
,, depression, 1 degree.
Charge, 7·7 lb.
Muzzle velocity, 1,476 f.s.
Projectiles, weight of common shell, 45·86 lb. ; bursting charge, 2·42 lb. ; shrapnel contains 583 balls.

N.B.—The gun, which is not allowed any recoil, is muzzle-pivoted and counterbalanced by the weight *c*. The cupola and gun are just overbalanced by the counter-weight *d*. A second counter-weight *e* is provided, by which the motion is brought under control. It is intended that the shock of recoil shall free a detent holding up the cupola, and allow it to drop automatically.

[To face page 82.



21-CM. SPHERICAL MORTAR, SHIELDED.
(SCHUMANN.)

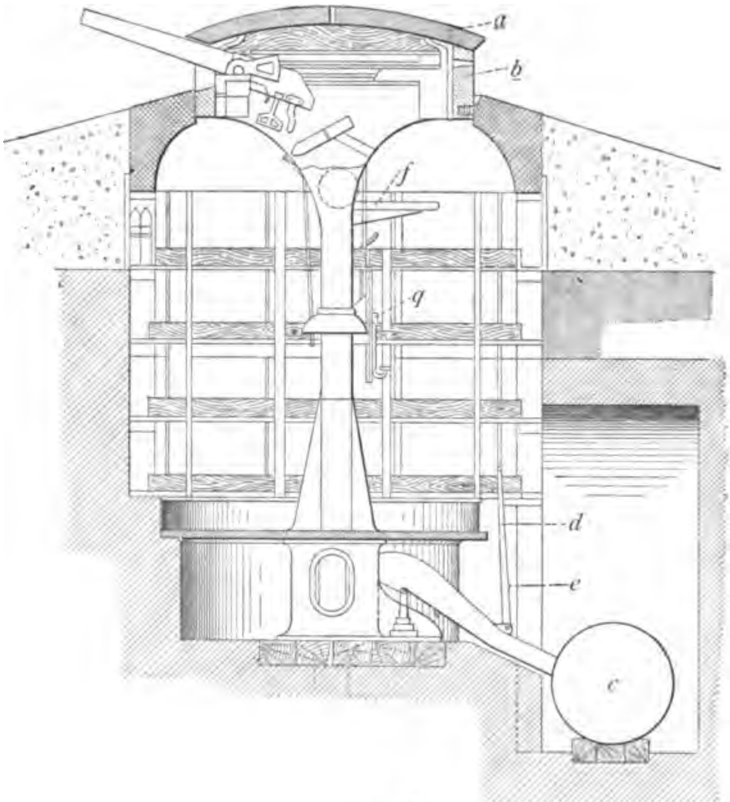
DETAILS OF MORTAR, ETC.

Length, 6·5 calibres.
Weight, about 5·3 tons.
Maximum elevation, 60 degrees.
Minimum „ 30 degrees.
Charge, $7\frac{3}{4}$ lb.
Muzzle velocity, 702 f.s.
Projectile, common shell, weight, 176 lb.; bursting charge, $7\frac{3}{4}$ lb.
Effective range about 4,000 yards.

N.B.—No recoil is provided for; the spherical surface strikes against the glacis plates, and the structure then recovers itself.

Detachment, 3 men.

[To follow Plate XI.



Scale $\frac{1}{30}$

12 6 0 1 2 3 4 5 6 7 8 9 10 Feet

DISAPPEARING CUPOLA FOR 58-MM. Q.F. GUN.
(SCHUMANN.)

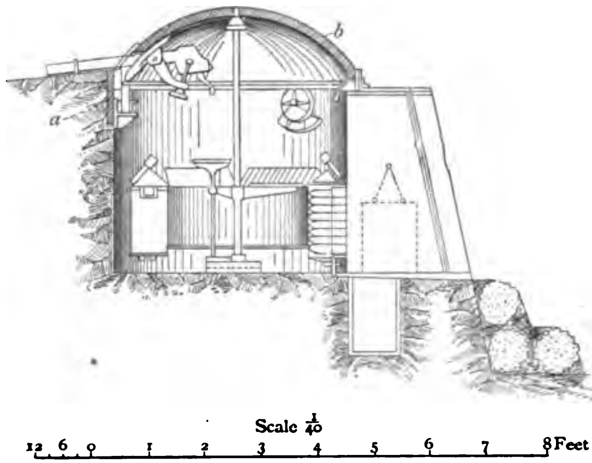
DETAILS OF GUN, ETC.

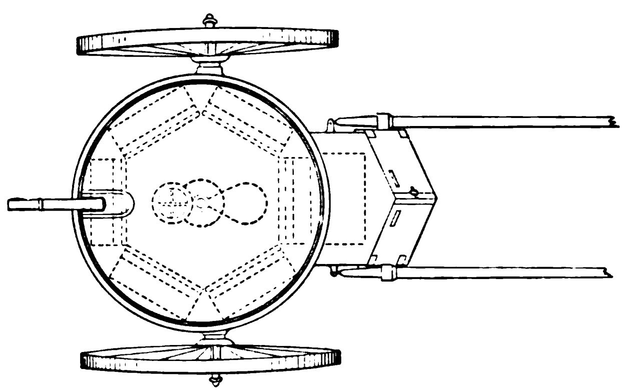
Length, 24·4 calibres.
Weight, 330 lb.
Rate of fire, 12 to 15 rounds per minute.
Maximum elevation, 18 degrees.
„ depression, 15 degrees.
Charge, 12¾ oz.
Muzzle velocity, 1,492 f.s.
Projectile, weight of common shell, 5¼ lb.; bursting charge, 2¼ ozs.; case contains 80 balls.

Thickness of roof plate *a*, 3·9-inch W.I.
„ side „ *b*, „ „
Total weight with glacis plates, about 12¾ tons.
N.B.—The cupola is just over balanced by the counter-weight *c*. By pulling up the bar *d*, the structure is made to descend, and is held by the catch *e*. On freeing the catch, the cupola ascends. The firer sits on a seat *f* and traverses the cupola by placing his feet on the spokes of a vertical wheel *g*.

[To follow Plate XII.

Plate XIV.





"Travelling Shield Mounting."
(Schumann.)

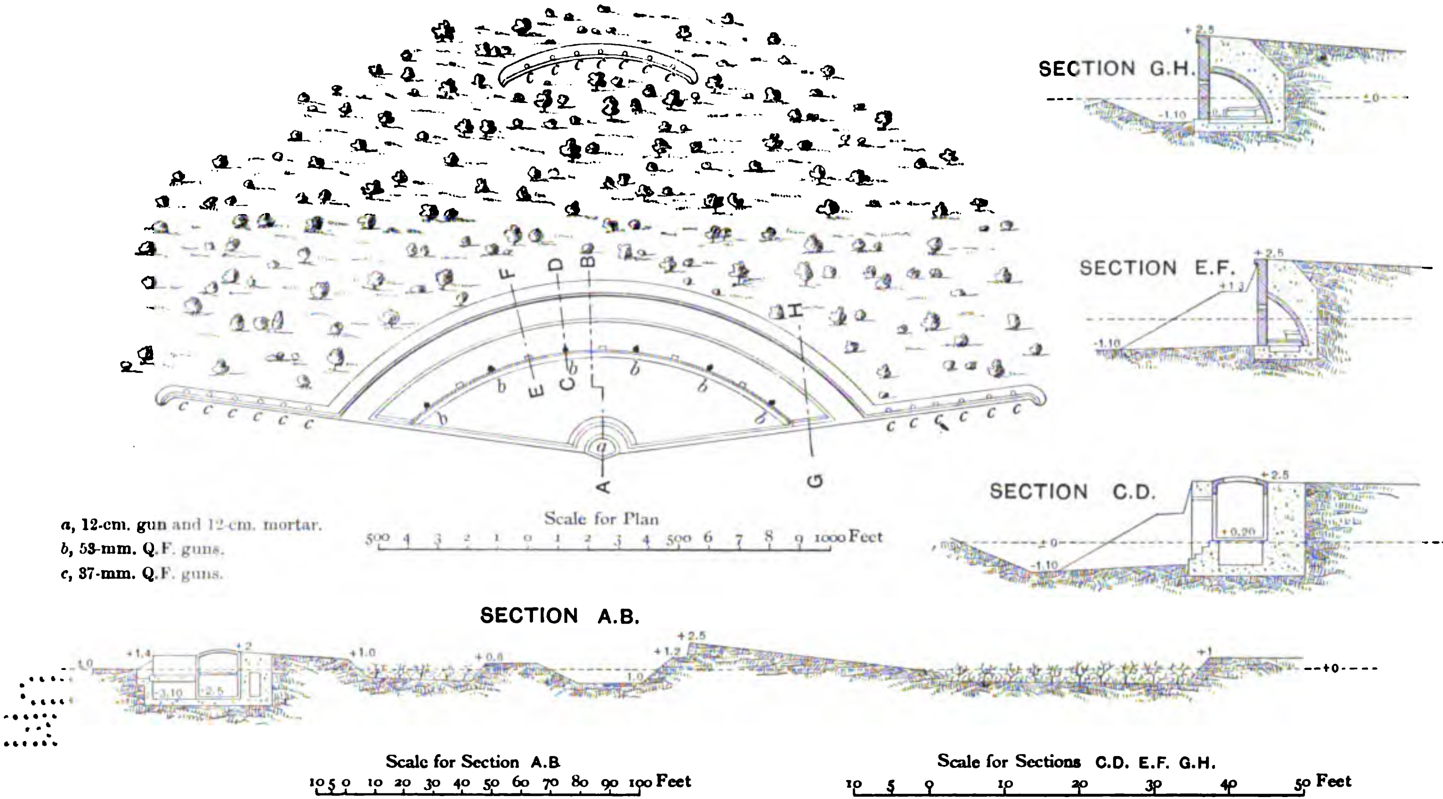
Details of Gun, etc.

Length, 22 calibres.
Weight, 81½ lb.
Rate of fire, 20 rounds per minute.
Maximum elevation, 10 degrees.
,, depression, 5 degrees.
Projectile, weight of common shell, 1 lb.; bursting charge, ¾ oz.; case contains 21 balls.

Charge, 2¾ oz.
Muzzle velocity, 1,332 f.s.
Thickness of front plate *a*, 2-inch W.I.
,, shield *b*, 1½-inch steel.
Weight of mounting and gun, 1¼ tons.
Magazine holds 400 rounds.
Detachment to work gun, 2 men.

[To follow Plate XIII.

PLATE XV.



TYPICAL WORK. (SCHUMANN.)

ARMAMENT.

One 12-cm. gun in disappearing cupola.
Two 12-cm. spherical mortars.

Six 53-mm. Q.-F. guns in disappearing cupolas.
Twenty-one 37-mm. Q.-F. guns in travelling shield mountings.

[To follow Plate XIV.

outside, and all the operations of loading, etc., must be performed by artificial light.

The disappearing cupola for the 53-mm. quick-firing gun (Plate XIII.) is similar in general arrangement. Little sight-holes are, however, provided in the side armour, so that, by raising the cupola, a view of the field of fire can be obtained. Fire is directed from the outside, and "*si la voix du commandant n'est pas suffisante, on transmet signaux à l'aide du petit cornet suisse.*"

The "travelling shield mounting," or portable cupola (Plate XIV.), is a cylindrical iron box furnished with a turtle-back armoured roof which revolves about a central spindle. By means of a pair of wheels and shafts the whole structure, which weighs 1¼ tons without ammunition, can be transported by horse draught, and placed against a natural or artificial bank, or buried in the ground up to the level of the lower edge of the roof shield. The shield and gun rotate together, enabling the latter to be fired all round the circle. A sight-hole is provided, but the fire must be mainly directed by word or signal from the outside, since the field of view at any given position of the cupola is extremely limited, and a small amount of smoke would obscure vision.

The mortar (Plate XII.) is of spherical form, the muzzle and breech having a small protrusion as shown. The spherical portion is made to fit a circular opening in the top of a domed chamber formed by four chilled iron plates. The mortar itself rests upon a pillar partly formed of wood, and capable of rotating about its vertical axis. The recoil is taken upon the chilled iron plates in rear of the position in which the mortar is fired. There is no light in the chamber, and all laying is performed by directions from an outside observing station.

A similar form of mounting is provided for a 12-cm.

spherical mortar, but the cast-iron dome is replaced by a brick and concrete chamber covered with a horizontal shield.

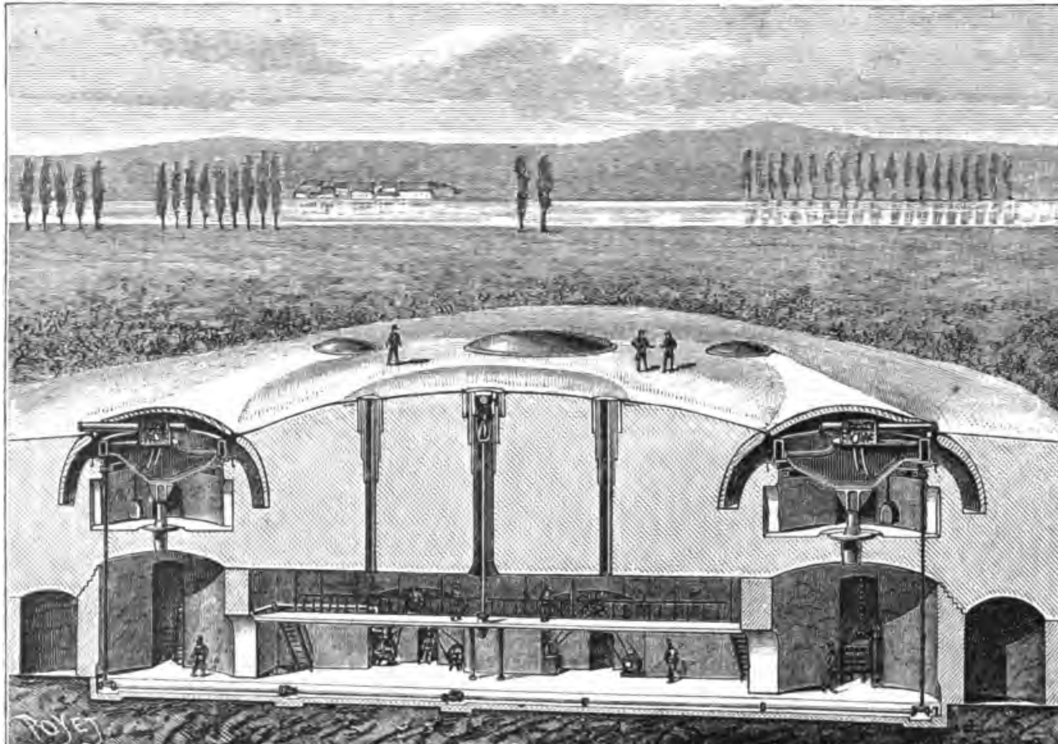
General von Sauer, of the Bavarian Artillery, regarded detached forts of the accepted type as useless, and proposed to employ a line or lines of two-gun cupolas, intended to play the *rôle* of the famed towers of Linz. He maintained that each cupola would constitute an admirable observing station, and that its armament could only be silenced by the heaviest siege artillery at ranges not exceeding 1,000 m. Allowing an interval of 600 m. for a single line of cupolas, or 1,200 m. if there are two lines arranged chequerwise, a total of 100 cupolas is required for a perimeter of 60 km., and their garrisons would amount only to 2,000 men. Thus economy in men and in the cost of the works was claimed.

General Schott held that as few positions as possible should be fortified, and that the inducements to bombard should be reduced to a minimum by placing all military stores outside the town to be defended. His main line of defence consisted of lengths of "detached fronts" 700 m. long, mounting fifty to sixty guns, and protected on the flanks by strong works, each provided with twelve machine-guns capable of a total delivery of 28,000 bullets per minute. The detached fronts have a ditch 4 m. deep with obstacles, and the flank works have deep revetted ditches. In advance of the main line are placed Schumann cupolas. There is no *enceinte*.

M. Mougin, a director of the St. Chamond firm, is the inventor of a cupola, and of a new system[1] of Fortification depending upon it. His fort is simple in conception, consisting of a huge block of concrete (Plate XVI. and Figure, p. 99) buried in the ground, and carrying on the top three

[1] "Les nouveaux explosifs et la Fortification," 1887.

PLATE XVI.



SUBTERRANEAN FORT. (MOUGIN.) SECTION.

[To face page 85.

cupolas (*a*, *a*, *a*), each mounting two 15-cm. guns. Four disappearing cupolas (*b*, *b*, *b*, *b*), each containing two machine-guns, complete the armament. Observing stations, electric lights, ventilating fans, and all the resources of science, are included in the block of concrete, which is to be garrisoned by thirty or forty skilled mechanics. The subterranean maze is entered by a well, cunningly guarded and closed by an iron armour plate, raised and lowered by a hydraulic ram. "The *portier* only sets the lift in action when he has heard the countersign and when the *tourelle à éclipse de garde* has recognised the arrivals." In the tunnel below the lift "a number of *chicanes* analogous to those which the engineers of the Middle Ages" delighted to employ are provided for the annihilation of an enemy who has gained admittance by stratagem. There is no ditch, and the self-defence of the fort depends upon the eight machine-guns. To defend the intervals and supplement the Artillery fire of the forts it was proposed to provide a double line of railway encircling the position, and covered by a rough parapet planted with shrubs. Trucks carrying guns on hydro-pneumatic mountings run on the outer line, and being provided with a double set of wheels, can be transferred to branch lines at right angles. Thus this movable armament can be brought into action at any position along the line of rail and can be rapidly concentrated; while, by means of cross lines, individual guns can be transferred to the inner line of railway and moved along the rear of other guns in action. Great economy was claimed for this system, which was estimated to cost from one-third to one-half the sum required to create a fortress of previous type possessing equivalent resisting powers.

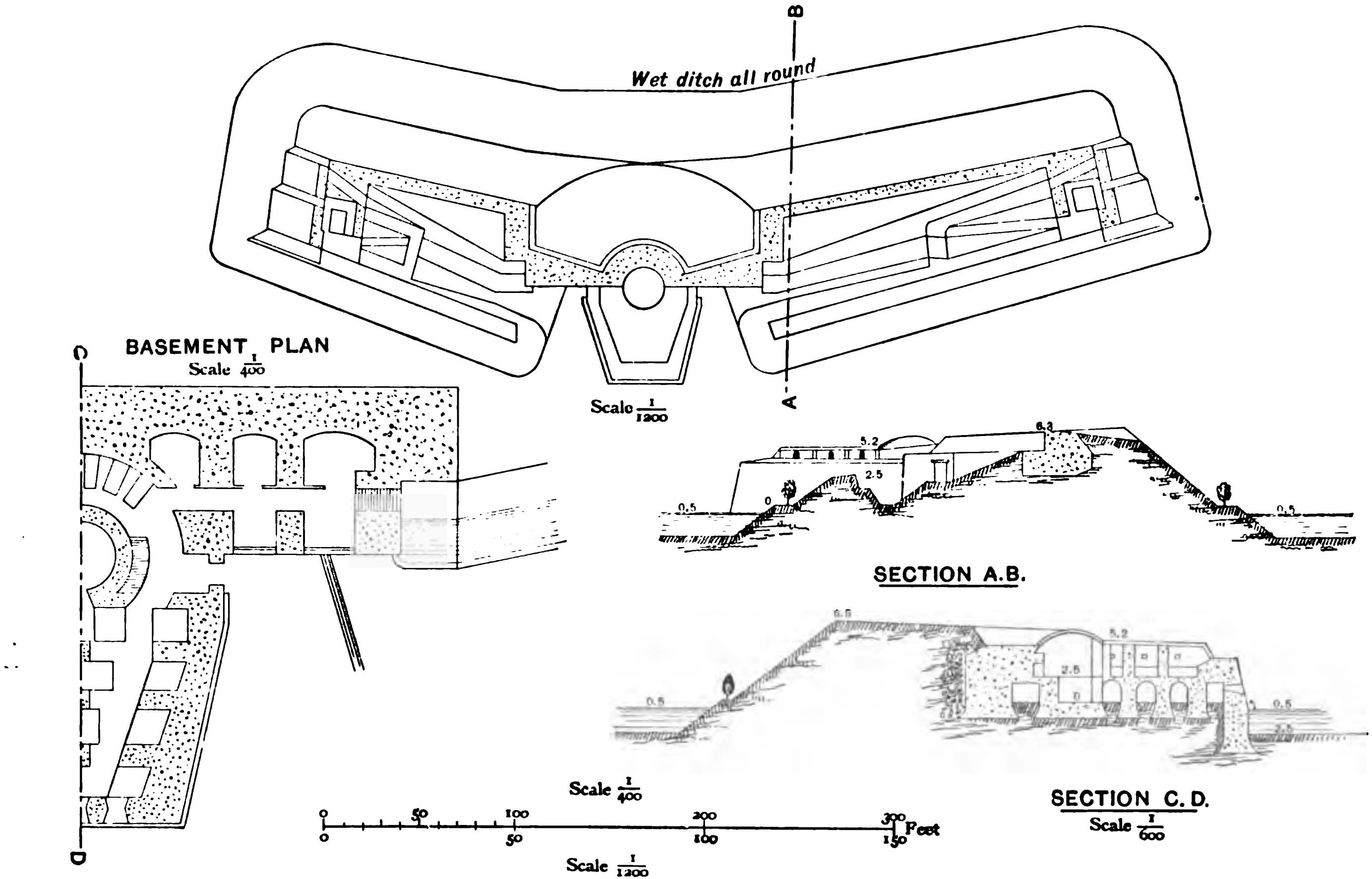
Lieutenant-Colonel Voorduin, of the Dutch Engineers,[1] proposed a novel combination of concrete and iron. His forts,

[1] "Projet d'un Fort satisfaisant aux exigences actuelles,' 1887.

2,200 yards apart, consist of a long mass of concrete covered in front by an earth parapet (Plate XVII.). Over the centre of the rear line of this mass is mounted a two-gun cupola, and protruding to the rear immediately behind this cupola is a casemated shielded caponier battery mounting three guns on each face, by which the intervals between adjacent forts are flanked. The form of the fort is simply a parapet broken slightly outwards at the centre, and in rear a second nearly parallel, but considerably lower, parapet forming the gorge. There is thus practically no interior space, and the garrison are housed in the rear caponier battery, and in casemates built into the concrete mass. A wet ditch surrounds the work, flanked in rear but not in front, by the caponier battery. The main Artillery defence is entrusted to concealed batteries placed between the forts. This system was devised to meet the conditions of flat, featureless sites, such as those of Holland.

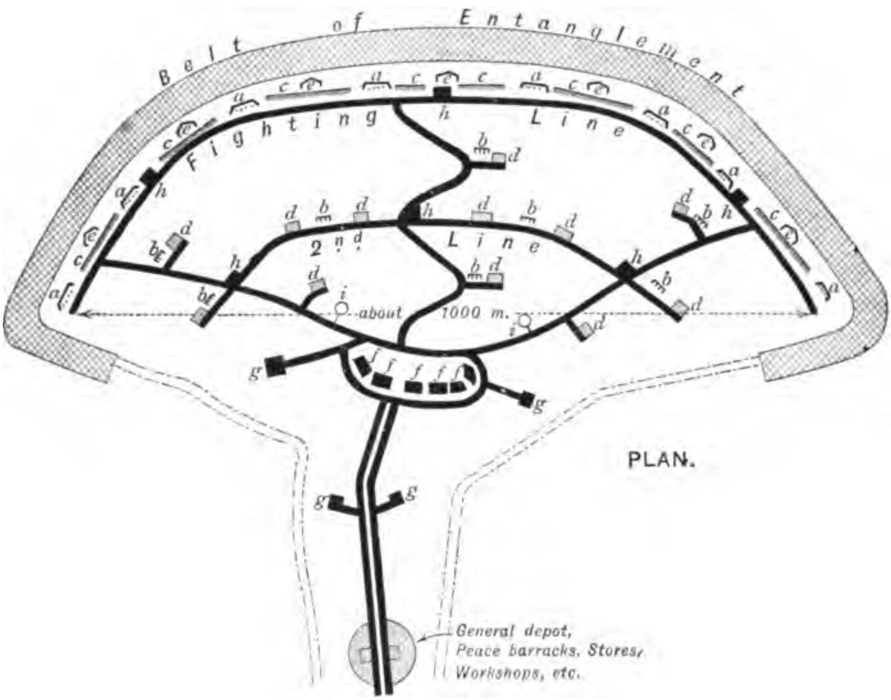
"*Un Pionnier*"[1] abandoned works of existing type altogether, and disbelieving the theory of complete protection, advocated the decentralization of the fort and its replacement by a group of batteries, Infantry trenches, etc., provided with an encircling belt of permanent entanglement 100 feet wide. Plate XVIII. shows the general idea of this defence by "dispersed elements." The fighting line contains eight batteries (*a, a, a* . . .), each of four guns. Between these batteries there are simple lunettes (*e, e, e* . . .) for Infantry defence, and the available space permits of the establishment of supplementary guns completing the war armament. A railway runs along the rear of the fighting line, and disappearing guns on trucks are freely employed. The ordnance intended for indirect fire is placed in a second line. About 600 yards in rear of the fighting

[1] "Les Forts et la Mélinite," 1888.

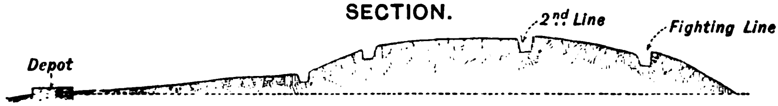


TYPICAL DESIGN FOR A FORT. (COL. VOORDUIN.) GENERAL PLAN.

[To face page 86.



SECTION.



a. Batteries for permanent armament
b. Emplacements for indirect fire
c. Emplacements for war armament
d. Shelters for men
e. Infantry works
f. Bomb proofs
g. Cartridge Stores
h. Stores
Line of epaulement and "Accessory defence"
Line of Railway
i. Observatories

TYPICAL DIAGRAM OF A FORT.
("UN PIONNIER.")

[To follow Plate XVII.

line, and apparently on the reverse slope of the position, is the "*élément passif*"—*i.e.*, a group of bomb-proofs to accommodate stores and to shelter one-third of the garrison. The rest of the barrack accommodation is provided for by dispersed buildings not bomb-proof, and placed near the lines of railway. The powder magazines also are to be dispersed, and to hold not more than 20 tons each. Special attention is to be given towards securing the invisibility of the works. The estimated armament of such a group of "elements" is sixty guns, and the garrison 750 men.

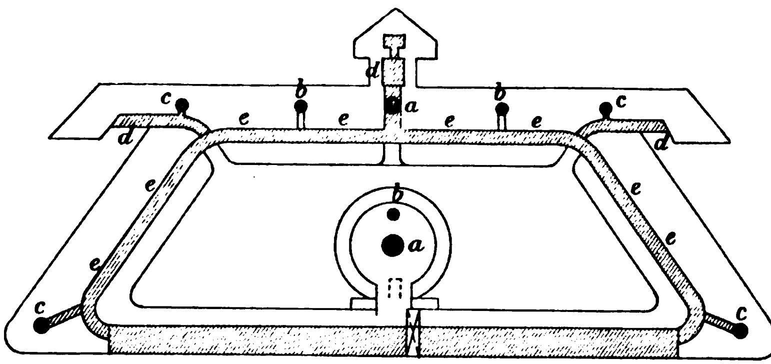
The late General Brialmont, in "La Fortification du Temps Présent" (1885), practically retained the familiar type of detached fort with great command, but since "*l'emploie des batteries cuirassées s'impose à la défense,*" cupolas are interpolated both on the ramparts and in the reduit. The cupolas are to be protected by *bonnettes* of earth to be cut down as the enemy approaches. Rifled mortars are employed in conjunction with the cupolas "*pour riposter à l'ennemi.*" Every fort liable to systematic attack is to have a reduit, and every fortress an "*enceinte de sûreté*" capable, apparently, of resisting a second siege, and provided with armour-plated batteries running on a line of railway. The forts have all the usual artifices—*caponiers* "*à oreilles de chat,*" *machicoulis*, etc. A minimum height of 7 m. is prescribed for escarps, but railings are elsewhere commended, and it is not by any means clear what is really considered the best treatment of the ditch. "The most redoubtable" mode of attacking a fort is said to be the employment of "*ponts volants,*"[1] but even this danger can be met by providing *coupoles à éclipse,* which are accordingly

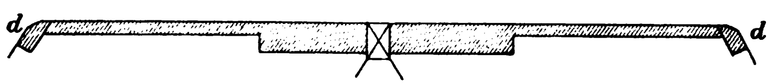
[1] The "*pont volant*" of the French army at this period was a harmless portable gangway used for the entrainment of horses and military carriages.

favoured. The book abounds in apparent contradictions and instances of special pleading.

In a later work[1] General Brialmont discussed the effect of the introduction of large shells, charged with a high explosive, upon Fortification generally, and proposed modified designs of forts. There are more cupolas, and the bomb-proofs are strengthened. *Coupoles à éclipse* figure largely, and there are various alterations in detail, but in general conception the works remain practically unchanged.

TYPICAL FORT (BRIALMONT).





a, *a*, Cupolas for two 15-cm. guns each.
b, *b*, *b*, Cupolas for one 21-cm. howitzer each.
c, *c*, *c*, *c*, Cupolas, disappearing, for one gun each.
d, *d*, *d*, *d*, Flanking casemates.
e, *e*, . . ., Underground communications.

The sketch given in the Figure explains one of the types of fort designed by General Brialmont—a large work with a front of about 250 yards and a depth of 160 yards, designed for Artillery defence.

[1] "Influence du tir plongeant et des obus torpilles sur la Fortification," 1888.

In the designs of the forts on the Meuse, General Brialmont adopted M. Mougin's concrete citadel, and surrounded it with a heavily flanked ditch on a triangular or four-sided trace. All the means of communication are subterranean.

Thus a majority of the authorities cited was in favour of a wholesale recourse to armour protection, which is made the basis of some of the systems proposed. It will be noted that in these cases all idea of Infantry defence practically disappears.

General von Sauer, Lieutenant-Colonel Schumann, and M. Mougin proved the courage of their convictions by frankly accepting the cupola and founding their projects upon it. "*Un Pionnier*" alone rejected the fascinations of iron Fortification, and, selecting M. Mougin's preposterous artificial mountain defended by mechanics for special condemnation, easily succeeded in demolishing the "*gigantesque bloc en béton*" which General Brialmont regarded as "*excellent*" in conception, and later adopted.

The idea dominating these projects was evidently that the increased power of Artillery and the employment of large high explosive shells would quickly render *hors de combat* all a defender's guns, and that by putting the latter behind armour they would secure immunity, and would obtain such an advantage that Infantry might be dispensed with, the fort becoming practically an Artillery position alone. Before accepting this proposition it is necessary to consider the questions involved.

It is of importance to know that at Bourges the dreaded "*obus torpilles*" produced craters 30 cm. (about 12 inches) deep in concrete, but when it is added[1] that from six to eight such shells must fall on an area from 1 to 2 m. square in order to breach a thickness of 1·50 m., a fresh set of

[1] "Influence du tir plongeant," etc.

considerations is introduced, on which target practice can throw some light.

During the long and costly experiments carried on at Bucharest in 1885-86, 164 rounds were fired from the Krupp 21-cm. mortar at targets of about 40 square metres area without obtaining a single hit. The range was 2,700 yards; the targets were towers built upon a level plain; the shooting conditions were ideal, and the fall of each shell was telephoned back to the firing-point; but it must have been evident to the least instructed observer that to attempt to group six or eight shells on an invisible area 2 metres square would have been absolutely futile. Superadd siege conditions, and the worthlessness of the data, on the strength of which General Brialmont provided casemates with vaulting from 2·50 to 3 m. thick, and even allotted 7 feet 6 inches of concrete under 9 feet of earth to the counterarches of a counterscarp, will be evident.

The basis of much of the disagreement of the professors probably lies in their varying appreciation of the significance of the results of target practice. For the purposes of Fortification, however, it is the probability of being hit which alone has to be considered, and while it is always interesting to know the maximum possible effect of individual projectiles, this information may have no bearing whatever upon the question of design.

If by any process of enchantment a soldier's body could be rendered impervious to shot and shell save for an area of 3 or 4 square inches, he would move about under fire with remarkable equanimity. He may be killed, but his chances of escape are considerable. The relative immunity from danger which Mr. Jorrocks claimed for hunting as contrasted with war would be reversed. If equal or greater chances are provided for a gun, a casemate, or a cartridge store, the reasonable requirements of war may be fulfilled,

since absolute security is incompatible with combatant action.

Erect a target on the far side of a belt of wood, and a person of the dullest imagination standing beside a gun on the near side will rise to a conception of the futility of shooting. If, however, a map or a chart is under consideration on an office table, the theorist will detect with triumph a patch of water—perhaps within a few yards of a dangerous reef—whence a vessel can fire a shell which *may* enter at the rear of a perfectly invisible emplacement and *may* render its gun *hors de combat*.[1] The fact that, in accordance with the ordinary laws of probability, the ship might fire into the air for several years before such a hit could be looked for is ignored, and even the elementary principles of ballistics are sometimes set aside by a mind imbued with an indiscriminating dread of being "taken in reverse."

Similarly, the assertion that a few yards of parapet can be "enfiladed" is frequently considered as conclusively damnatory of a design. It is, of course, disastrous under certain conditions to be either taken in reverse or enfiladed; but the sole measure of the danger is the probability of being hit, or, in other words, the practicability from the enemy's point of view of carrying on more than blind fire. In considering the effects of Artillery fire upon works of defence it is the probabilities of hitting which alone need be taken into account. Blind fire into the unknown, and all fire which cannot be regulated by observation, are necessarily as ineffective against land Fortification now as formerly.

The relative probability of obtaining hits under different circumstances, upon which many of the questions of Fortification mainly depend, is unfortunately difficult to determine. Careful and prolonged experiments would go far to settle differences of opinion, since the cardinal objec-

[1] This is no imaginary case.

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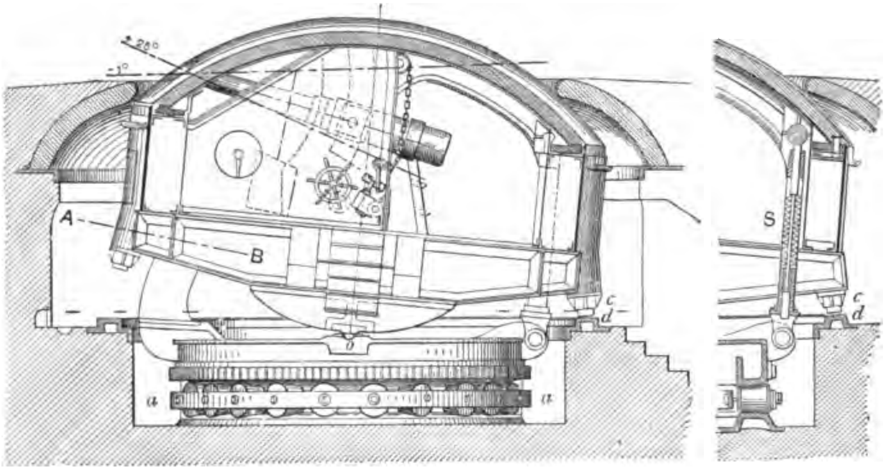
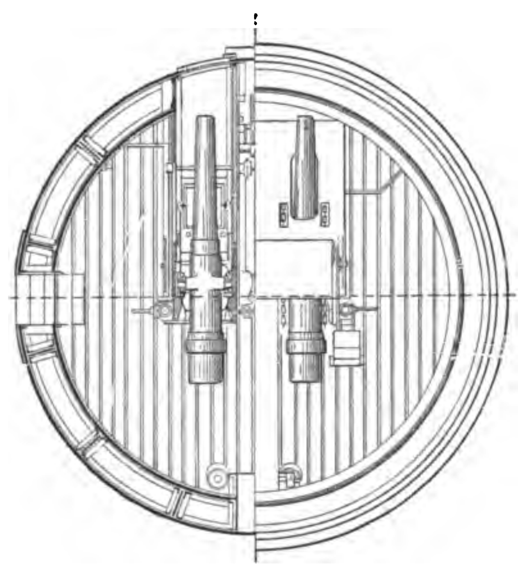


OSCILLATING CUPOLA FOR TWO 150-MM. GUNS.
(MOUGIN.)



HALF-PLAN AT A.B. HALF-PLAN, SHIELD REMOVED.

[To face page 98.

repeatedly disabled under service conditions. These experiments practically provided no data as to the real resisting power of the cupola, and their principal result was to render the spherical form of shield universal in later designs of non-disappearing type.

A remarkable design carried out by the St. Chamond firm at Langonand, and purchased by the Roumanian Government for the defences of Bucharest, is shown in Plate XIX.[1] In order to give complete protection to the gun-ports, the cupola is made to oscillate about a horizontal axis *o*, the whole weight being transferred from a rounded knife edge working into an inverted saddle carried upon a turn-table *a*. An opening through the centre of the system affords space for a vertical pillar serving as a guide to an ammunition lift worked from the chamber below the gun-floor, and conveying two projectiles and two cartridges to the guns at each ascent. The whole cupola is equilibrated by two trains of powerful Belleville springs, S, which are neither extended nor compressed when the centre of gravity of the structure is vertically over the axis of oscillation. Rotation is effected by means of a hand-winch carrying a chain of which one end is attached to the gun-floor, the other to the turn-table below, Belleville springs being employed at each attachment to deaden shock. In the firing position, the cupola is tilted up till the leg *c* rests upon the rail *d*. The leg contains strong Belleville springs under permanent compression, which receive the whole shock of recoil. The two 15-cm. guns are independently counterpoised by weights, which allow them to be easily depressed or elevated. Traversing is performed by a winch in the chamber below, which turns a spindle carrying a pinion gearing into a toothed arc surrounding the turn-table.

[1] Taken from "Le Génie Civil."

The ideal of the many cupola designers—complete protection to guns and men, except at the instant of firing—appears almost to have been attained in the oscillating structure above described, as well as in the disappearing cupola (Plate XI.). The one exposes only a port, a few inches in diameter, for a short period before firing, and is nearly invulnerable to direct fire at all other times; the other is altogether invisible and unattackable by direct fire, except for a few moments before and after each round.

At first sight, these modes of mounting may appear to possess a certain fascination. To be able to fight in safety has obvious advantages. The cupola guns, we are told, will be available to the last stages of a siege. The besiegers will be driven to put special ordnance into the trenches, or to bring up shells of vast capacity charged with high explosives. This, and more, is claimed, and to some minds the arguments in favour of the cupola in one or other of its many forms may appear conclusive.

There are, however, other aspects of the matter which are frequently overlooked. By accepting the cupola, the guns are tied down to fixed positions, which immensely simplifies the difficulties of the siege train. If the high-angle fire, against which General Brialmont provided 9 feet of concrete over his casemates, is ever to find a favourable opportunity, it will surely be against a cupola, the site of which can generally be determined with accuracy. To dislocate these machines, it will not be necessary to cut through a great thickness of concrete, and the besieger's howitzers would be able to shell a cupola deliberately without any possible reply from its direct-firing guns. It is considered necessary, therefore, to provide mortars to protect the cupolas, one section of the fortress armament being thus employed in guarding another. Unless large structures are introduced, requiring steam or other power, the cupola

guns must necessarily be weak, those of the disappearing structure (Plate XI.) being especially feeble, judged by modern standards. At Bucharest the accuracy of the fire from the cupola was by no means satisfactory, for reasons easily understood. The same guns would have shot far better and far more rapidly from ordinary siege mountings. The disappearing and the oscillating systems appear unlikely to give results equal to those obtained at Bucharest.

Again, there are grave disadvantages in rendering the armament of a fortress wholly dependent upon observing stations and telephones, or electric dials. If the observer is killed, or the observing station wrecked, or if communication is interrupted, the cupola becomes helpless unless provided with sights and a manhole in the shield, which its partisans warmly repudiated. A gun which can be aimed only so long as telegraphic communication with an outside observer exists loses much of its value. The indirect fire armament of a fortress must of necessity depend for its accuracy upon observing stations, but can at need be controlled by visual signals. Every direct-firing gun ought to be able to be laid by sights. Finally, difficulties both of lighting and of ventilation, easily obviated in peace experiments,[1] may assert themselves unpleasantly in actual war.

While, therefore, guns mounted in cupolas are subjected to some grave disabilities, it is by no means clear that the real protection, gained at much sacrifice, is as great as has been claimed. It may well be doubted whether the armament of a cupola of the non-disappearing type would survive a gun on an overbank carriage capable of being readily moved from one emplacement to another; while howitzers

[1] The St. Chamond turret at Bucharest, which had no manhole in the roof shield, was extremely defective in these respects, notwithstanding that the chamber immediately below the gun platform had a large doorway opening directly into the air instead of being sunk below ground.

employed in the defence can be so concealed as to be practically secure from injury.

Even if relative immunity from danger could be conceded to the cupola gun, other considerations arise, of much importance in comparing rival modes of mounting.

"The cost of the French turret (at Bucharest) was about £10,000, exclusive of its armament, and for this sum about six movable overbank guns of greater power could be provided."[1] Unless siege warfare is to be regarded in the light of a duel on the backwoods principle between guns in fixed positions, all tactical handling of the defence being put out of sight, it may well be doubted whether a movable armament of equivalent cost would not be infinitely more effective from the defender's point of view. The great advantage possessed by the attack in all ages has been the employment of a mobile Artillery against armaments cribbed, cabined, and confined by Fortification. Is it necessary to perpetuate this advantage?

In order to protect the cupolas, General Brialmont proposed to provide rifled mortars encased in armour (Plate XII.), and if mortars are to be placed in the target forts designed by the author of "La Fortification du Temps Présent," there may be some grounds for this ant-lion form of mounting. Otherwise there appears to be no justification whatever for the great expense and the other drawbacks involved.

The disappearing cupola, which General Brialmont regarded as the antidote to the "*pont volant*"—some resuscitated expedient of the Middle Ages—and which he proposed to render capable of resisting guns of "*calibre moyen*" in the second artillery position, is a creditable manufacturer's design. Two or three men buried in a subterranean chamber

[1] Official Report by Major D. O'Callaghan, R.A., and Captain G. S. Clarke, R.E.

lighted by a lantern are, at the right moment, to raise their cupola and deliver an overwhelming fire in the right direction. The mechanical principles are apparently sound; the arrangement will probably work so long as it is not hit by anything heavier than a rifle bullet. The price is satisfactory—to the makers—and purely military considerations can be ignored.

On these machines it has been sought by some authorities to base the Fortification of the future; but there is no indication of any attempt to show how the defence is to be carried on. Take the typical battery (Plate XV.), in which one officer, six non-commissioned officers, and seventy-five men are locked up by twos and threes in iron boxes, and distributed from 450 to 1,000 yards apart, some partially, the rest wholly buried in the ground. Endeavour to lay down some mode of controlling the defence as a whole, or of giving any sort of direction to the fighting. The difficulty will be apparent to anyone accustomed to consider tactical questions. Let it be remembered further that the defenders practically see nothing of what is going on around them, except through little loopholes, which, in the case of the disappearing cupolas, are buried till the moment comes to emerge.

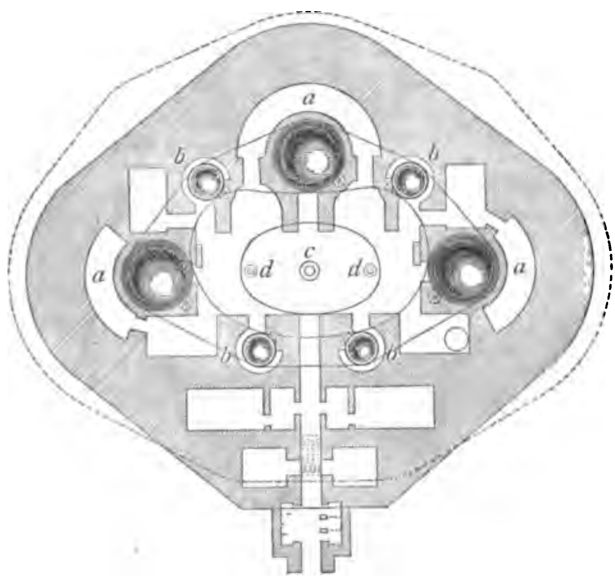
Given a dead-level, featureless plain, or a uniform glacis, and an enemy who will attack in broad daylight on a given line with a front of given breadth, a plan of action can be conceived. The ground over which the attack is to take place might be divided up among the different cupolas, the correct orientation of each laid down and marked on the arcs accordingly, and the necessary elevation of the guns for a grazing fire ascertained. At the sound of the bugle, the disappearing cupolas rear their heads, and the whole collection of pepper-pot lids twist themselves into position and come into blind action till the "cease fire" is sounded.

With a well-exercised garrison, this would perhaps be practicable, although, in the excitement of the action, many of the combatants would lose their nerve, forget their chalk marks, and fire far over the enemy's heads. Men who would distinguish themselves for bravery if their comrades were within sight would unquestionably disappoint expectation if thus buried alive in dispersed iron boxes completely hidden from their officer's eye.

The assumptions above made are, however, precisely those which could not be realized, and it requires little imagination to picture the wild confusion which an attack in the grey dawn would create in defences of this nature applied to ordinary topographical conditions. No one would know what was happening, or from what side the danger was coming. There would be no command, no unity of purpose. The cupolas would raise themselves prematurely, and disappear when their fire was most needed. The combat would be more unequal than that between good modern cavalry and the ironclad knights of the Middle Ages, who would be ridden through and through and rolled over like so many helpless ninepins.

M. Mougin's typical fort (see Figure, and also Plate XVI.) is practically a mastless turret ship buried up to the deck-line in concrete and manned by mechanics. Difficulties and inconveniences of many kinds have to be accepted when a fort is required to steam across the seas, but to introduce them gratuitously in an aggravated form on land appears to be madness. War will never be carried on by machinery, nor can forts be defended by *méchaniciens*. Machinery can aid Fortification only within limits. An accident to the disappearing observing station by day, or a temporary failure of the electric light by night—contingencies by no means improbable—would render this subterranean fort helpless, while the garrison, distributed among

labyrinthine underground chambers and ignorant of what was transpiring, would be in the worst possible position for receiving and acting upon orders or dealing with a sudden emergency. Strong field works and an effective field force calculated on the usual scale would be needed



Foundation Plan of Mougin's Concrete Fort.

a, a, Gun Cupolas.
b, b, Machine-gun Cupolas.
c, Observing Station.
d, d, Electric Lights.

to guard a fort of this description, and would at the same time render it practically superfluous.

The interpolation, as in the figure (p. 88), of a circular central reduit containing two cupolas and surrounded by a deep ditch flanked by a counterscarp gallery seems peculiarly ill-conceived. The gun cupola would not have any

better chances of survival than the rest of the armament of the fort, while the howitzer cupola would be useless if the outer portion of the work were captured.

Subsequent to the Bucharest trials a long series of experiments with cupolas was carried out at Chalons. The results were kept secret, and the armour plates were even buried. The experiments do not appear to have been suc-

A Strengthened Barrier Fort.

cessful, as the French have not shown any marked predilection for armour in this form. In Germany and elsewhere, however, cupolas have been added in some cases to existing works, and on the Continent generally much strengthening of forts has been carried out. This has taken the form of providing thick concrete overhead cover for dwelling casemates, flanking chambers, and guns intended to fire only in one direction with a view to command restricted avenues

of approach. The figure[1] shows the interior of an old mountain barrier fort thus strengthened, the rounded form of the exposed concrete masses being adopted in order to deflect high explosive shells.

While, therefore, the application of cupolas in connection with new constructions has been practically confined to Belgium and Roumania, where General Brialmont's designs dominated the policy of Fortification, the system has been adopted to some extent in works of old type which have been strengthened.

Both the South African and the Russo-Japanese Wars have revealed the possibility of bringing powerful guns into the field, and it is clear that railways will enable comparatively heavy ordnance[2] to be used for siege purposes, thus further discounting the feeble armaments of the cupolas. At the same time the importance of rifle fire in the defence of positions has again powerfully asserted itself, while the immunity of well-placed guns using indirect fire has been strikingly manifested.

[1] Taken from an article in the *Kriegstechnische Zeitschrift* (No. 9, 1905), translated in the *R.E. Journal*, September, 1906.

[2] In the South African War, 9·45-inch howitzers, weighing with the carriage-body, etc., about 9 tons, and firing a 280-pound shell with a lyddite burster of 53⅛ pounds, were taken into the field. A 9·2-inch gun, weighing about 23 tons, was mounted on a 3 feet 6 inch gauge railway-truck, from which it could be fired, and was sent to the front, while 11-inch howitzers were placed in battery and used with great effect at Port Arthur.

CHAPTER IX

THE SOUTH AFRICAN WAR—THE RUSSO-JAPANESE WAR—PORT ARTHUR

THE South African War throws no direct light upon any question of permanent Fortification. Pretoria was defended by four forts of orthodox pattern, Johannesburg by one such fort, and the possibility of being compelled to attack them was taken into consideration.[1] If, when the British forces arrived before Pretoria, there had been an organized garrison, amply supplied with food and ammunition, a prolonged resistance might have been offered. The forts could not have been captured by assault, and siege operations, which would have been extremely inconvenient, must have been undertaken. These conditions were not fulfilled, and the rapid advance of Lord Roberts from the Vaal ensured the surrender of Pretoria. Thus the Boers, who showed tenacity in holding positions hastily entrenched, were compelled to abandon a town expensively and deliberately fortified, and the only advantage they derived from their essays in permanent Fortification was that the armaments provided for the forts could be employed with effect in the field. Permanent Fortification was, in fact, unsuited to the requirements of the strategic situation, and, as always in such cases, it proved valueless.

[1] A siege train was extemporized for this purpose, as no organized units existed.

In the technical details of field defences the Boers showed little originality; but their natural aptitude for seizing on the tactical features of a position was almost invariably displayed, and they had fully grasped the supreme advantages of invisibility. The natural conditions of South Africa combined with the use of smokeless powder to conceal entrenched positions to an extent never previously attained. Before the battle of Colenso, it was impossible to ascertain by observation where the Boers were posted, or to form any idea of their probable strength, and the only effect of the Artillery preparation prescribed as the necessary precursor of an Infantry attack was to indicate plainly the intentions of the British General.

The Boer trenches were generally narrow and deep, without head-cover for the firing line. As soon as they could be located, therefore, the fire of the defenders could be kept down or temporarily silenced by shrapnel, while howitzer shells, unless bursting almost in the trenches, were harmless. In South Africa, as in Manchuria, it was generally impossible to dislodge riflemen from entrenched positions by Artillery fire, which, however, when well directed and sustained, proved capable of preventing reinforcement from the rear, inflicting loss on reserves, and supporting an Infantry attack to a late period, as notably at Pieter's Hill.

The most recent war experience all tends to show that tactically the defence has relatively gained by the development of weapons and by the adoption of smokeless powder, as was anticipated.[1] The failure with heavy loss[2] of the successive attacks on Plevna, which at the time gave rise to some surprise, has been followed by similar failures, which indicate that the difficulties of attacking entrenched positions has been distinctly increased by the progress of

[1] *Cf.* 1st Edition.

[2] More than 700 officers and 31,000 men killed and wounded.

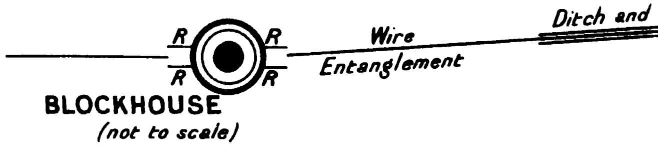
armaments. Such positions, if their flanks are secure, can now be held with less numbers than formerly, and as the reduction of numbers permits, in many cases, a large extension of front, flanking movements have become correspondingly difficult. It follows that hasty entrenchments will be more and more extensively employed in the field by armies engaged both in offensive and in defensive operations, and that a correct understanding of their powers and limitations will exercise a marked influence upon strategy.

The conditions of the South African War were in many respects exceptional. Thus the recourse to passive defence on a vast scale by the largely superior invading force—one of the most remarkable features of the campaign—must not be regarded as affirming the principle that the mobility of a numerically inferior enemy can best be counteracted by resorting to a wholesale immobility.

The construction of blockhouse lines began in June, 1901, and subsequently attained enormous dimensions. Before the end of the war these lines had reached a total length of about 3,700 miles, with more than 8,000 blockhouses. The number of men per mile allotted to their defence varied from thirty-eight (Harrismith to Bethlehem) to eighteen (Wonderfontein to Komati Poort). The longest individual line (from Victoria Station on the Western Cape Colony Railway to Lambert's Bay on the Atlantic) was about 310 miles. The blockhouses were at first constructed $1\frac{1}{2}$ miles, later $\frac{3}{4}$ mile, and on the Ermelo-Standerton line only 700 yards apart. Great ingenuity was displayed in designing these buildings, which were of several types, varying from light structures formed of wooden frames and corrugated iron to substantial stone towers.

The intervals were closed with continuous wire entanglements having light trenches on each side, which were

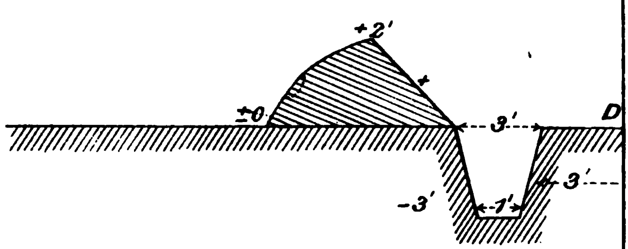
TYPE OF BLOCKHOU



).

Each blockhouse surrounded by
10 feet from edge of block
R. R. rests for Rifles on edge o
attempted to cross at night.

TYPICAL SECT



A single deep wide ditch used
Flare Lights or Spring Guns f
on account of rocks.
The Top wire A. and the Stays
C. C. C. C. barbed wire.
D. D. strong wood or iron pick

gradually strengthened (Plate XX.).[1] In addition, there were chains of posts, or isolated posts, scattered liberally over the whole theatre of war, the system imposing sedentary duties on a force which must have had a total strength about ten times that of the Boers latterly in the field.

The conditions of the campaign—the sustained mobility of the enemy, the vital need of maintaining railway communication, and local disaffection—inevitably entailed dispersion of force. For the protection of bridges, culverts, stations, etc., against an enemy having no Artillery, blockhouses were well suited, and the railway-wrecking operations of the Boers, which culminated at the end of 1900, forced the military authorities to adopt them. The system of continuous lines, like the Great Wall of China and the *trocha* constructed by the Spaniards across the island of Cuba, being intended for a strategic purpose, while apparently violating a strategic principle, has, however, incurred criticism. By reticulating South Africa with lines of obstacles, it was hoped to deny whole districts to the Boers, or, if they happened to find themselves inside the fortified paddocks, to drive them against the entanglements by movable columns, and to secure surrender. Whether the success obtained justified the time, labour, expense, and extreme dispersion directly and indirectly involved appears doubtful. "It was impossible to prevent their" (the enemy) "crossing by night, though, no doubt, they got to like this less and less as the lines got stronger and stronger."[2] To be effective, therefore, the drives required to be timed so as to reach the blockhouse lines in daylight, and this the Boers were generally able to avoid.

Their great and prolonged mobility, the wide area of the

[1] "The Blockhouse System in the South African War," by Colonel E. H. Bethell, D.S.O., R.E. Professional Papers, vol. xxx., 1904.

[2] Colonel Bethell. General de Wet in his book makes light of the blockhouse lines.

operations, and the absence of geographical objectives, combined to invest the proceedings subsequent to the occupation of Pretoria with marked irregularity. The inevitable results of the initial misconception enshrined in the historic telegram, "Unmounted men preferred," could not be quickly remedied, and when it became evident that mobility was of primary importance, a wholesale improvisation of forces found favour. Thus, in place of mounting trained and hardened soldiers, new bodies without any previous organization and containing material partly indifferent or unprepared, were hastily created. On the one hand, therefore, large numbers of excellent troops found themselves without any worthy military employment, and on the other hand the new and inchoate levies required several months of training and experience to become a match for the alert and instinctively military Boers, while the preventable waste of horses assumed large dimensions. In such circumstances, the construction of 3,700 miles of defensive blockhouse lines in face of a numerically far inferior enemy was, perhaps, a natural development. The principles of strategy, however, remain unchanged, and it may be hoped that Fortification in this form will not repeat itself. Great caution is needed in drawing lessons of permanent value from the South African War.

Dating from the 30th July, 1904, on which day the Japanese, after a series of actions beginning with the battle of Nanshan, forced the Russians back upon their fortifications, the siege of Port Arthur lasted 154 days, thus equalling in duration that of Kars (1855) and slightly exceeding that of Plevna (1877).

The Chinese had fortified Port Arthur extensively on the sea-front, and had neglected the land side. When, therefore, the Japanese, following innumerable precedents,

attacked the back door on the 21st November, 1894, they were opposed only by a few weak earthworks and by the so-called "Chinese Wall," a long rampart protecting the town on the north.[1] After the Russian occupation, a considerable scheme of Fortification was prepared and approved by an Imperial Ordinance of the 31st January, 1900, which allotted a million roubles per annum for carrying out the works. By the end of 1903, six principal forts (A to F; see map) and five intermediate works (*a* to *e*) were wholly or in part completed, together with an *enceinte* about 3¾ miles long, which was necessarily useless, the East and West Pan-lung redoubts, and some batteries in, or in rear of, the main line. By the date of the beginning of the siege the two advanced positions—the group of works on and near 203 Metre Hill on the north-west, and Fort Kuropatkin, with adjacent defences designed for the protection of the waterworks, on the north—had been constructed, and the fortifications of Port Arthur had assumed the scope shown in the map.

The forts (A to F) and the intermediate works (*a* to *e*) were of conventional type, with ditches about 30 feet deep, flanked by counterscarp galleries at the angles. The total length of front thus fortified was about 9½ miles.

Thus, as at Sebastopol, but on a larger scale, light trenches developed into strong field works, prolonging the line of permanent forts on the left, guarding the intervals, providing a second or third line of defence in some places, and affording covered communications.

Excluding the guns of the coast defences (p. 179), and about sixty field guns either placed in batteries or used as movable armament,[2] the Russians had mounted in the

[1] The main Japanese attack was directed against a weak earthwork occupying the site of Fort D, I-tzu-shan (see map).

[2] The field guns were used in the early stages of the siege principally. In addition there were thirty-five Hotchkiss guns and seven 6-inch Q.F.

works of Port Arthur about 175 guns and howitzers. Among the former were 24 6-inch Q.F., 48 6-inch B.L., 9 4·7-inch Q.F., and 58 12-pr. Q.F. The latter included 10 9-inch and 10 6-inch. The three types of Q.F. guns were on naval mountings. The number of howitzers (20) was small in proportion to the total armament, the Russians having failed to realize the advantages of the high-angle fire of large shells in the defence of a fortress.[1] On the other hand, indirect fire from guns was largely employed at Port Arthur, as in the great battles in Manchuria, being forced upon both combatants by the necessities of modern war.

Against the fortress armament the Japanese eventually brought to bear about 230 siege pieces and about 240 field guns. The former were of many types, ranging from the 11-inch howitzers taken from the coast forts to a 3½-inch mortar. The total number of howitzers and mortars was about 84, approximately one-third of the total, excluding field guns. The 11-inch howitzers, 6-inch naval guns, 6-inch mortars, 4·7-inch guns, and 4·7-inch howitzers constituted the most powerful element in the siege armament, which, weak at the beginning of August, was steadily strengthened, six 11-inch howitzers arriving in September and the remaining twelve in October.

The hills around Port Arthur did not provide positions well adapted for defence, the ground being much broken up into small, abrupt spurs, with many irregular underfeatures and deep ravines, which, in some cases, did not follow the ordinary watercourse lines, and afforded cover to the attack. Moreover, the general line occupied was too near (3,000 to 4,500 yards) to the town and dockyard. Even the advanced position on 203 Metre Hill and Long Hill was less than 6,000 yards from the anchorage. The

[1] *Cf.* 1st Edition.

ground generally was favourable to trench work; but in places there was much rock. Altogether the natural advantages for defence were inferior to those of Plevna.

The Russian forces numbered about 50,000 men,[1] of whom slightly less than one half were effective at the time of the surrender. This force would have provided an average of about three men per yard for the whole front (9½ miles) of the main line; but the losses of the Russians before they were driven in upon their defences were considerable, and a further deduction must be made for the garrisons of the purely coast works. Averages of men or of guns per yard are of extremely little value, on account of the other important factors which determine the resisting power of a fortress. It may be noted, however, that the resources in men and in guns of Port Arthur were less in proportion to the length of the line to be defended than those of Sebastopol.[2]

From the Russian point of view a strenuous resistance at Port Arthur was inspired by the considerations that—

1. The harbour sheltered and supplied the fleet, which, having failed in two attempts (12th April and 10th August, 1904) to effect its escape, subsequently remained inactive.

2. It was doubtless hoped that the large naval force to be sent from Europe might, in whole or in part, by evasion or after fighting, reach Port Arthur and be able to refit.

3. If the Japanese decided to undertake a serious attack on Port Arthur, large numbers of troops would be occupied, and prevented from taking part in the northward movement.

[1] The garrison proper of Port Arthur was fixed at about 11,300 men—a strength which would not have sufficed to hold the place for a month. Only the much larger force actually employed enabled a protracted defence to be offered.

[2] Line held about 4 miles long. The Russians towards the end of the siege had 982 guns in the first line (p. 32).

4. The occupation of Port Arthur by the Japanese would provide them with a sea-base, supplementary and possibly superior in some respects to Dalny, and would, therefore, facilitate the oversea invasion of Manchuria.

On the other hand, the Japanese, in deciding to capture Port Arthur at all costs, may have reasoned that—

1. As long as the harbour provided a refuge for the Russian fleet, their sea communications would be endangered. (This consideration must have lost weight when it became clear that the fleet was sedentary.)

2. The removal for the time of all naval menace, however small, would simplify their arrangements and permit an overhaul and refit of their own warships.

3. The capture of the Russian ships lying in Port Arthur would be a desirable addition to their navy.

4. If the squadron coming from Europe could not be brought to a decisive action, or if it were only partially defeated, a friendly harbour in a strategic position far superior to that of Vladivostock would enable the Russians to give further trouble at sea.

5. When the time for negotiating peace arrived, the principle of *beati possidentes* could be asserted with effect.

Whatever may have been the motives on both sides which determined the siege and the tremendous fighting around Port Arthur, it is clear that—as always in such cases—the naval situation was the dominating factor. The Japanese navy, as a whole, was numerically far inferior to that of Russia, and though a working command of the Sea of Japan was established from the time at which it became evident that the Russian Far Eastern squadron was unable or unwilling to act on the offensive and had no object except to evade its antagonists, the menace of the large force to be sent out from Europe could not be ignored. The time which would elapse before this new

element could appear upon the scene was probably under-estimated. The appalling inefficiency of the squadron which Admiral Rodjesvensky was to lead to disaster could not be foreseen, although the Dogger Bank incident was peculiarly illuminating. Moreover, by the middle of May, 1904, the Japanese had incurred the misfortune of losing two battleships and a protected cruiser[1]—not as the result of fighting—and although the ships which had been engaged had not suffered appreciably, this was a serious diminution of the initially smaller navy.

It is at least certain that if the Japanese had entered upon the war with the stronger navy, the importance of Port Arthur—from the point of view of both combatants—would have assumed a different aspect. The Japanese would have had no inducement to court heavy sacrifice in capturing the fortress, and would have been able to concentrate effort upon the Manchurian campaign, knowing that decisive success in the field would entail the fall of Port Arthur. On the other hand, the Russians might have abandoned Port Arthur, sinking their ships to prevent the use of the harbour, as at Sebastopol, and withdrawing the garrison before the Japanese could bestride the Liao-tung Peninsula, thus adding 50,000 men to the army of Kuropatkin.

The moral is many centuries old. The value of fortresses, on a seaboard or inland, depends upon the action of sea-going fleets and field armies, and Fortification, if not applied in strict conformity to national policy, invariably fails in its objects. It may raise side issues and deflect strategic plans ; but it will not compensate for defects or insufficiency in fighting ships and field forces.

[1] *Hatsuse, Yashima, Yoshino.* In addition, the *Fuso,* armoured coast-defence vessel, and the *Takasago* protected cruiser, were lost in September and December respectively.

The operations at Port Arthur are interesting and instructive, although the brilliant assaults of the Japanese deprived them of the character of a normal siege. Sebastopol, if attacked immediately after the concentration of the Allies on the south side, with the vigour shown at Port Arthur, would undoubtedly have fallen.[1] When the Russians, after the prolonged fighting beginning with the battle of Nanshan (26th May), were driven back upon Port Arthur, the Japanese were confronted with defences enormously stronger[2] and far better manned than those which the Allies were unwilling to assault at the end of September, 1854. At Sebastopol, however, the Russians could be reinforced, and were able gradually to create a fortress and even to threaten with a field army the flank of the position held by the Allies; at Port Arthur, they were hemmed in and limited to the existing resources.

Eagerness to capture the fortress, combined with an underestimate of the tenacity of their opponents and of the resisting power of earthworks, led the Japanese to impose impossible tasks upon their devoted Infantry. Where they failed no troops could have succeeded, and it is doubtful whether any other army would have stood with equal fortitude the heavy strain resulting from the methods adopted.[3] Impatience characterized the operations from first to last. The construction of regular siege approaches was not begun till the end of August, and the great assaults of the 30th October and the 26th to

[1] "Neither the exaltation of the troops nor their resolve to fight to the last extremity could have saved Sebastopol, if the enemy had attacked it immediately after his passage of the Tchernaya."—Todleben.

[2] The first shot of the war was fired on 8th February, and Dalny was not occupied till the 30th, while the first great general attack on Port Arthur began on the 19th August. There was, therefore, ample time for trench work.

[3] The total losses in killed and wounded amounted to about 60,000 men. The German estimate is "about 80,000."

27th November were certainly premature. Even when mining was resorted to, attempts were made to storm the permanent forts before practicable breaches had been effected.

The general course of events (see map) was as follows :

22nd August.—East and West Pan-lung-shan redoubts in main line captured by assault, but practically useless to the Japanese.

20th September.—Capture of Fort Kuropatkin and the northern group of advanced defences.

5th December.—Capture of the north-western group of advanced defences, 203 Metre Hill, etc.

18th December.—Capture of first permanent work in main line, Fort B, Tung-chi-kuan-shan, North.

28th December to 1st January.—Capture of whole north section from X to Sung-shu-shan (*c*).

2nd January.—Capitulation signed.

The Japanese do not appear to have realized from the first the importance of 203 Metre Hill. The capture of this position, which quickly sealed the fate of the Russian fleet, might have been worth heavy sacrifices ; but the great assaults were spread over a wide front and directed against the strongest portion of the defences. Heavy losses were thus incurred without direct results, although the magnificent display of fighting power may have exercised a moral influence upon the Russian garrison.

On the one side were impetuous troops and commanders eager to capture Port Arthur with the least delay, unprovided at first with adequate siege appliances, and desirous of avoiding a resort to systematic methods. On the other side were forces traditionally dogged and tenacious in defence, holding permanent fortifications which had been largely supplemented by field works before the siege began, and able to add continuously to their strength. Such conditions

were exactly calculated to entail heavy total losses, and to lead to the severe fighting at close quarters which characterized some phases of the operations.

The verdict must be that the Japanese expended life too recklessly and without adequate compensation in shortening the duration of the siege. On the other hand, the Russians might have prolonged the resistance for a short time, although little would have been gained thereby. After the 1st January, 1905, the Japanese would have been able in a few days to bring up heavy Artillery, and from Wang-Tai and 203 Metre Hill the whole of the interior of the position was commanded.

While, as always in considering the experience of war, deductions must be received with caution, and while in this case there were disturbing conditions which necessarily qualify conclusions, the siege of Port Arthur unquestionably provides lessons which have an important bearing upon the problems of permanent Fortification.

For the first time in history we have an example of a siege, partly, at least, systematic, of a position defended by a line of permanent detached forts of modern type[1] approximating to the conventional standards. It is evident that these forts would, by themselves, have been hopelessly inadequate, and that the resisting power of Port Arthur depended mainly upon earthworks hastily constructed in front, in the intervals, and in rear of the permanent line, and upon the action of field troops in sorties and counter-attacks.

As Artillery positions the permanent forts proved practically worthless, as might have been expected. They provided prominent targets upon which it was easy to concentrate a heavy fire, destroying their armaments,

[1] Begun in 1900, and presumably representing Russian ideas at that date.

and keeping their garrisons under bombproof cover. Useless as Artillery positions, they were far inferior to the field trenches for the purpose of Infantry fire. They were, however, *sturm-frei*, and their ditch flanking arrangements could be effectively attacked only by mining.[1] Thus, in the case of Erh-lung-shan Fort, the counterscarp galleries were first destroyed by mines on the 20th November, and on the 28th December part of the scarp and parapet of the front face were blown up. During the interval an assault was attempted and was repulsed.

What function, then, did the permanent forts discharge in the défence of Port Arthur? It may be assumed that they—

1. Denied the occupation of certain prominent positions, which, if captured, would be advantageous to the Japanese.
2. Compelled a resort to mining for their capture.
3. Provided reasonably secure and comparatively comfortable quarters for their garrisons, which, however, while kept inside them, could contribute nothing to the general purposes of the defence.
4. Served as store-houses and as magazines.

More cannot well be claimed for these forts, and it is at least clear that, standing by themselves, they could not have guarded the intervals. Whether they might have been of value as Artillery positions if armed with cupolas of the types (Plates XI. to XIII.) adopted in the defences of the Meuse appears doubtful. In this case, their Artillery power would have been necessarily weak, as pointed out (p. 95), while a concentrated fire of heavy shells, such as those of the 11-inch howitzers employed by the Japanese, would probably have sufficed at least to dislocate the

[1] Attempts to destroy the counterscarp galleries by charges of high explosives rolled over or hung from the crest of the glacis were not successful.

mechanical arrangements and thus to render the armaments *hors de combat*.

In any case, it may be accepted as an axiom that lines of forts such as those at Liége and Namur, respectively about 30 and 24 miles in length, with intervals exceeding 6,000 yards in some instances, are incapable of defence unless garrisoned by strong field forces and supplemented by field defences on a large scale, with an ample Artillery armament independent of the permanent works.

Concealment of the Artillery positions, both in attack and in defence, proved of the utmost importance. In the choice of sites from this point of view, the Japanese showed much greater aptitude than their opponents, not disdaining such simple means as the planting of millet stalks to hide their guns.

The defenders of a fortress, if not cramped by Fortification, should possess the advantage of a superior organization of Artillery fire thoroughly thought out in advance; but the fire of the Japanese, though somewhat purposeless at first, was afterwards systematized to an extent never attained by the Russians. Some of the guns of the latter, however, could never be located, and the Artillery of the defence generally, wherever it was well placed, proved practically immune. On the other hand, guns on conspicuous sites, standing up against the sky-line, seem to have been invariably put out of action as soon as the Japanese Artillery turned its attention to them.

It is certain that, if the trammels imposed by conventional Fortification can be broken down, the Artillery of a fortress can be enabled to play a far more important part than in the past, and to be vastly more effective than at Port Arthur. This, however, will demand a high standard of organization, permitting the fullest use of indirect fire controlled by careful observation. The transport and

mounting of the eighteen 11-inch howitzers by the Japanese was a most creditable performance, indicating what may be expected in future sieges. On the other hand, the Russians, who had ten 11-inch and twenty 9-inch howitzers in their coast forts, where they were not required, seem to have made no attempt to bring them to the front.[1]

High explosive shells were largely used, and were effective locally, though they seem to have done little damage to the structures of the permanent forts. At Fort B, Tung-chi-kuan-shan, North, which was heavily bombarded, casemates protected by 4 feet 6 inches of concrete were not breached, and when falling on concrete slopes the shells appear to have glanced. Field bombproofs, even when heavily timbered, were opened out ; but showed considerable resisting power in cases when iron plates were placed under the baulks. Structures of this nature must depend for security mainly on invisibility and on small depth from front to rear. The employment of high explosives in the form of hand grenades on both sides and as bombs fired from wooden mortars[2] by the Japanese is noteworthy. Thus used at close quarters, high explosives doubtless have great moral as well as material effect.

While the permanent forts of Port Arthur showed defects of design, in the arrangements at the gorges especially, they answered their purpose as enclosures secure against assault. So much may be expected from any work provided with well-flanked ditches and good bombproof protection, and technical refinements can add little or no advantage. The front faces of the forts were retrenched in some cases by obstacles and a line of field parapet across the terreplein

[1] These howitzers and the heavy guns of the coast defences, which were all turned to the rear, were able, especially on the right flank, to contribute to the defence.

[2] Ranging up to about 300 yards

These, with the assistance of machine guns brought up at the last moment, enabled assaults of the breaches formed by the mines to be repulsed. The Japanese soldiers made excellent miners; but the underground work, as a whole, was not well directed, and might have been far more effective, especially if prosecuted with vigour against the field works in the intervals between the forts. It is not certain that the mining operations contributed materially to the reduction of the defensive power of Port Arthur. The Russians made no real use of countermines, which might have aided the defences materially. Considering the immense system of countermines developed by the garrison of Sebastopol, this is surprising.

The Russian trenches, like those of the Boers, were frequently deep, which enabled head-cover to be provided while minimizing the size of the target. Loopholes were largely used, and were sometimes combined with overhead protection. This, even when slight, served its purpose so long as invisibility was secured, and, in any case, offered a very small object to the fire of the Japanese. Traverses were employed to localize the effect of a chance shell, or to defilade exposed portions. Such trenches, following the general contour of the ground, were able to flank adjacent works. Great development of rifle fire was thus possible, while rear lines of trenches were available to check an assault which had succeeded in breaking across those in front. Long belts of entanglement were employed, and were duplicated in many places. On account of the lack of a sufficiency of suitable wire, however, and because the ground in places was too hard to allow the pickets to be properly driven, they were not nearly as formidable as such obstacles can be rendered.[1] *Abatis*, *trous de loup*,

[1] They were, for example, far inferior to the entanglements employed in South Africa.

and an electric wire fence across the centre of the position were also utilized. The Russians used machine guns with effect, frequently concealing them in light blindages, so that their positions could not be detected until they were brought to bear upon an attacking force. The little portable cupolas (Plate XIV.) might perhaps have found useful employment of this nature.

The attacking force at no period seems to have exceeded about 60,000 men, and was, therefore, considerably below the proportion usually regarded as necessary for such an undertaking. The Russians showed little enterprise in the form of counter attacks after the loss of the advanced positions, and having regard to their relative numbers, the defence appears to have been unnecessarily passive in character.

The defences of Port Arthur perhaps mark a transitional period in the art of Fortification. The conventional fort still appears as an Artillery position, and, as such, proves a complete failure. There is, however, a large recourse to batteries in the intervals and in rear of the main line. The general organization of the defence was indifferent, being doubtless improvised at the last moment. The supreme importance of careful forethought and study, if the utmost effect is to be obtained from modern Artillery, has not yet been realized. On the side of the attack, impetuous gallantry did not compensate for a lack of system, and the Japanese would have spared their fine Infantry, without loss of advantage, by resorting to formal methods at an earlier period. Although, for various reasons, the best results were not obtained from the weapons and appliances now available, the siege of Port Arthur deserves to rank as a memorable military episode, which demands the attention of all students of war, and throws much light upon the Fortification of the future.

CHAPTER X

EFFECT OF MODERN DEVELOPMENT OF ARMS—MAGAZINE RIFLES—HIGH ANGLE FIRE OF RIFLED HOWITZERS—QUICK-FIRING AND MACHINE-GUNS—SMOKELESS POWDER—HIGH EXPLOSIVES—TACTICAL REQUIREMENTS—OBSTACLES—USELESSNESS OF ENCEINTES AND OF REDUITS

Among the developments of modern arms which in a special degree affect the defence, none is more potent than the magazine rifle, possessing an effective range of about 2,000 yards, a maximum range of about 3,200 yards,[1] and a continuous speed of fire averaging at least fifteen aimed rounds per minute. An assaulting force when in movement cannot deliver an effective fire, and cannot advance without exposing nearly a full-length target to an antagonist who shows head and shoulders at most. This condition has obtained ever since the introduction of firearms. It is a constant factor in dealing with questions of attack and defence. Now that the effective range of the Infantry weapon has been multiplied by more than twenty, and its rate of fire by at least fifteen, an immense power has been conferred upon the defence, which no Artillery progress has neutralized.

However carefully an assault may be planned, there comes a stage at which the advance must be made without any support from Artillery fire. When the small arm was capable

[1] In the Russo-Japanese War the losses began to be felt at a range of about 2,200 yards.

of being fired only about once a minute, this zone could be crossed with comparatively little difficulty. The Artillery of the attack would endeavour to keep the defenders from their parapets until the last moment, and during that last moment the fire of the defence was necessarily weak. Hence arose the vast ditches, the elaborate arrangements of flank defence, the caponiers, counterscarp galleries, etc., of the various systems of Fortification. The modern rifle has rendered all these expedients unnecessary. The intensity of fire which a single line of men can now deliver upon a given area exceeds enormously the maximum formerly attainable by the combination of every conceivable system of cross-flanking. Infantry garrisons can be kept under cover till the last moment, and during the final rush, which must be made without Artillery support, the deadly effect of the magazine rifle has full scope. To guard against surprise, and to give that sense of security which is necessary even to the best troops acting on the defensive, an effective obstacle is necessary, which in some cases may be a ditch, but which can be effectively provided in other ways. A reveted ditch appeals to the imagination more powerfully than a sunk iron fence and a broad belt of entanglement or *abatis* under modern rifle fire, and this is a consideration which should not be forgotten; but, as an effective obstacle, the latter may be superior. A line of steady troops covered by a parapet, protected by such an obstacle under its fire, and amply supplied with ammunition, is unattackable by direct assault.

Further, the minimum field of fire necessary to shatter an attack has been immensely reduced. These are axioms frequently stated; but their logically inevitable significance in relation to Fortification has never been adequately recognised. There is no arm so potent in its influence on all questions of land defence as the magazine rifle.

"Artillery fire has immensely increased in range and accuracy." This is a military commonplace so often repeated that it is frequently accepted without further consideration. As regards direct fire, it would probably be more correct to say "the range of accurate fire has immensely increased." Accurate direct fire has long been attainable, provided that the range was sufficiently short, and the distinction is somewhat important. As regards indirect fire, however, the case is different. The mortar fire of the Sebastopol era was inaccurate at *all* ranges, and the realization of this inaccuracy unquestionably delayed adequate recognition of the great possibilities opened out by the modern howitzer and rifled mortar.

The accuracy attainable by this class of fire, even at considerable ranges, has immensely increased since 1855. Thus the Krupp 24-cm. mortar, weighing about 33½ cwt., is stated to give a probable rectangle[1] of 11 m. by 0·5 m. at a range of 3,314 m.;[2] and the 15-cm. mortar, weighing about 13½ cwt., a rectangle of 15 m. by 5 m. at 2,000 m.[3]

The table on p. 123 will serve to give some idea of the accuracy of our present siege ordnance.

While the idea of breaching hidden casemates by planting shells successively on a few square yards of area may evidently be dismissed as futile, it is certain that convergent high-angle fire may be extremely effective upon a horizontal target of moderate size. The accuracy of this fire will, how-

[1] The zone within which 50 per cent. of the shell fired may be expected to fall.

[2] "Bulletin de la Réunion des Officiers."

[3] "Recherches tactiques sur les formes nouvelles de la Fortification."—General von Sauer.

Such a piece as our 5-inch howitzer is well suited to accompany a field army in all cases where fortified positions may have to be attacked. At Plevna, for example, ordnance of this type would have been infinitely more effective than the siege guns of greater weight brought up by the Russians, who subsequently adopted a field mortar.

ever, depend entirely upon accurate observation; but inasmuch as *all* the high-angle guns of the defence can generally be so concealed as to be secure against everything except chance shots, their accuracy of fire should approach more nearly to the standard of peace practice than is possible in the case of guns using direct fire.

Knowing every inch of the terrain, occupying in most cases the commanding points, and being easily able to use balloons and other artificially elevated observing stations, the defence ought unquestionably to have the advantage in the effective

Nature of Howitzer.	Range.	Rectangle.	Angle of Descent.
	Yards.	Yards.	
9·45-inch howitzer Austrian model	3,000	29·0 by 4·7	60° 30′
	4,000	32·0 by 6·0	58° 28′
	5,000	35·0 by 7·2	62° 5′
8-inch howitzer (full charge) 276-lb. shell, M.V., 781 f.s.	3,000	21·0 by 2·4	17° 52′
	4,000	27·0 by 3·1	25° 30′
	5,000	35·0 by 3·8	37° 30′
6-inch howitzer (full charge) 100-lb. shell, M.V., 931 f.s.	3,000	19·4 by 5·2	12° 3′
	4,000	26·6 by 7·6	17° 25′
	5,000	34·6 by 10·5	23° 39′

employment of high-angle fire. If, for example, the high-angle guns of a fortress are concealed behind a belt of wood, it is hopeless for the attack to attempt to silence them. On the other hand, the defender is not constrained to have a wood within effective range, and his high-angle Artillery can be concentrated upon the first siege works which he is able to locate.

Moreover, the defender is in full possession of his position, has his guns in battery ready for action when the besieging force arrives in his front, and can have a perfectly organized system for the control and directing of fire. These are

distinct advantages, for the neglect of which there is no possible excuse.

Finally, overhead cover—*i.e.*, cover against high-angle fire—is precisely the kind of protection which the besieger finds most difficulty in providing.

On the above grounds, it may fairly be claimed that high-angle fire can be employed to the best advantage by the defence, and that its increase of accuracy is a definite gain which it should be one of the first objects of any rational system of Fortification to turn to the utmost account. From the point of view of the defence, the development of rifled howitzers is second in importance only to the introduction of the magazine rifle.

As regards the employment of direct fire, the conditions are more evenly balanced. On the one hand, it is usual to claim for the defence the power of employing heavier ordnance, of mounting it more efficiently, and of being able to protect it with iron. On the other hand, the besieger has generally been gratuitously provided with ideal targets, laboriously constructed at vast expense, and he offered in exchange low earthworks scarcely visible even in the open at moderate ranges.

Moreover, the besieger has sought and obtained far greater latitude of action than his opponent. He can modify the form of his operations to suit the circumstances, moving his Artillery as he chooses, and concentrating its fire at will upon a given portion of the line of defence; while the besieged, when fettered at every turn by arrangements pre-ordained by the professor, loses all initiative from the first and succumbs to superior tactical elasticity. Given a force commanded by a soldier with whom tactical considerations are paramount, opposed to another force placed in a strait-jacket by "*un théoricien . . . qui ne se rend pas compte exactement de la manière dont se passent leurs*

combats,"[1] the result is predetermined. It is easy to understand why, in all ages, the most brilliant defences have been made by earthworks constructed by soldiers for soldiers, the *théoricien* having been fortunately left in his office.

Fortress Artillery mounted in permanent defences has never yet been permitted to fight on equal terms, and has usually been overpowered with comparatively little difficulty for that reason. Where, as at Paris, guns were employed outside the expensive positions specially provided for them, they secured relative immunity; where, as at Belfort, they were frequently moved, they contributed valuable aid to the defence; where, as at Port Arthur, they were partly in forts and partly in temporary or semi-permanent emplacements outside, they were quickly put out of action in the one case, and were rarely injured in the other. The Fortification of the future must confer full freedom upon fortress Artillery, and the Artilleryman must insist on obtaining adequate recognition of the tactical requirements of his arm.

All field guns will shortly be of so-called quick-firing type, capable of effective shrapnel fire up to about 6,000 yards, and provided with bullet-proof shields covering the loading numbers. They will certainly find employment in future siege operations both in attack and defence. At Port Arthur, the Japanese had about 250 field and mountain guns, and the Russians had about 60, which here, as in the great battles in Manchuria, used indirect fire perhaps mainly. Shrapnel is capable of keeping down the fire from infantry trenches which can be accurately located, and of supporting an attack up to a late period by preventing the arrival of reinforcements. The experience of Port Arthur[2] showed, however, that where good head-cover existed shrapnel was ineffective.

[1] "Bulletin de la Réunion des Officiers."

[2] Confirming the experience of the South African War.

Small quick-firing guns of "pom-pom" type can be used to delay the advance of a sap-head, as portable shields afford no protection against their shells.[1] The exaggerated impression of their value which seems to have been created in South Africa was largely due to the generally inefficient and always deficient field Artillery fire of the Boers, and these guns are not likely to play an important part in the field in future wars.

The fire of the Maxim gun, delivering about 700 bullets per minute, can be directed by one man, who need not show more than his head (easily shielded) above the parapet, the feed being tended by another man completely under cover. In the special qualities of the machine gun there is a distinct advantage to the defence, arising from the fact that an intense fire over a particular area can be suddenly developed by a few men occupying a small space. This, in the case of night attacks especially, is a valuable quality. At Port Arthur, the Russians in some cases employed machine guns with good effect, concealing them so that their fire came as a surprise to the assaulting parties. Their extreme portability renders them well suited for the defence of positions, and they will doubtless form an important element in the armament of fortresses.

The introduction of smokeless powder has proved, as was expected, to be a source of advantage to the defence. As between two combatants, the tactical effect of smoke may assert itself in three ways :

1. The attacking force may find a local or a general advance facilitated by the visual cover afforded by the smoke of its own fire.

2. The defender may be shrouded in his own

[1] At Port Arthur, the Japanese used sand-bag parapets about 4 feet thick as a protection against the little shells of the 37-millimetre Hotchkiss gun, and in some cases made their saps 4 feet deep.

smoke at a moment when a well-directed fire is specially needed.

3. Smoke reveals to either combatant the positions held by the other, and, in particular, defines more or less exactly the number and sites of guns.

The suppression of smoke in cases (1) and (2) causes the balance of advantage to sway to the side of the defender, whose main object usually is to obtain the maximum effect of fire delivered from a fixed position, while smoke introduces variable and uncertain conditions which may aid the attack. In its absence, the gain lies with the best covered force, which, moreover, not being affected by the disorder incidental to movement under fire, ought evidently to be under better control, and is able to some extent to direct its fire in elevation by the slope of the parapets. In case (3) the advantage is perhaps less direct. Siege works are themselves comparatively invisible, but powder smoke serves to reveal gun positions. In the Artillery fight, therefore, the advantage from the absence of smoke might seem to lie with the attack, although the flash of guns employing direct fire is generally unmistakable. On the other hand, invisibility of works can be secured by the defence as soon as the old ideals are abandoned, and, if the smoke factor is expunged, the balance must sway to the side of the force best able to employ indirect fire controlled by a well-organized system of observation.

Shells charged with high explosives, now generally adopted, have not fulfilled all expectations. It was natural that their introduction should have given rise to panic in some quarters.[1] Fortifications constructed before 1885 were peculiarly unfitted to resist a concentrated fire of high

[1] Thus, a speaker at the R.U.S. Institution in 1890 appeared to contemplate the possibility of "clearing the Channel by picrates," by which he apparently intended to suggest that our fleets could be swept off the seas by high explosive shells.

explosive shells at high angles; but would have suffered little if at all less from shells charged with powder. Howitzers and mortars were developing in power and accuracy; delay-action fuses, which gave time for penetration before the burst, were beginning to be sought for; the French were experimenting with steel shells of large capacity to be charged with *mélinite*. The time had certainly arrived for considering means of strengthening existing forts in certain respects. Now that there has been some varied war experience of the effects of high explosves upon land defences, previous estimates of their powers have undergone modification. Locally most destructive, their radius of action has proved to be very limited, which detracts from their moral effect. Peace experiments carried out to ascertain their penetration are generally inconclusive, on account of the extreme difficulty in obtaining hits upon targets reasonably representative. Our own experiments up to 1897[1] appear to show that about 6 feet of hard concrete is capable of resisting the shells of the 8-inch B.L. howitzer, and that a system of sandwich protection offers no advantage. At Port Arthur, where the permanent forts were very heavily shelled, a thickness of about 4 feet 6 inches of concrete seems to have provided security against single shells, and the employment of a layer of rails appears to add materially to the measure of protection. When heavy shells fall on curved or sloping concrete surfaces they generally glance before bursting. The question of the exact thickness to be provided in future works of Fortification is, however, of minor importance. The main point is to lessen the chances of hits by invisibility and by small depth of target. Fighting cannot be carried on without incurring risks, and the accident of the fall of two heavy shells on the same spot—a remote contingency—need not be provided

[1] Since this year no experiments appear to have been carried out.

against. In the close attack, the use of high explosives in extemporized hand grenades proved effective; but on the whole it cannot be said that this modern development has materially affected the relative positions of the attack and of the defence. The advantage, if any, must incline to the force which is able to attain the greater accuracy and the higher standard of organization in the employment of high-angle fire.

Siege warfare is, in a sense, a combat between weapons of the same types employed under different conditions, and the discussion of the respective capabilities of these weapons will not alone suffice for the purposes of Fortification. Tactical considerations, which have the object of enabling the combatants to make the best use of their arms, should take precedence of all others. A fortified place must be, before all, a fighting position, and to the neglect of recognising this axiom may be traced the relative failure of the performance of permanent Fortification as compared with that of rough defences rapidly created to meet special needs. In the one case, tactical considerations were unfettered; in the other, alluring tricks of detail and the charm attaching to a science which it has been sought to represent as intelligible only to the few have led to the creation of structures which cramped the defence from the outset.

Thus the fascinations of monumentalism have frequently proved irresistible. A large building is a more specious advertisement of the genius of its architect than the most cunningly devised piece of landscape gardening. Even works so inherently vicious as Picklecombe and Garrison Point still, perhaps, convey a powerful impression to the lay mind affected mainly by size and apparent massiveness.[1]

[1] Just as the appearance of H.M.S. *Dreadnought*, when going out of Portsmouth Harbour, is reported to have inspired with "awe" spectators who had not the smallest knowledge to enable them to judge her fitness for war.

Political Fortification, of which there have been numerous examples here and elsewhere, would, therefore, naturally tend to take the form of an appeal to the uninstructed instincts of the many. Unless Fortification ceases to be regarded as a species of cult, a thing apart from the ordinary rules of war and common-sense, real progress must necessarily be delayed.

While the besieger has derived full advantage from superior mobility, the defender has been locked in the toils imposed by the Engineer, with the inevitable disabilities they entail. An anchored ship, even if possessing superior armour protection, would clearly be heavily handicapped in an engagement with inferior vessels under way.

To hold a fortified position may imply strategic immobility; but, from a purely tactical point of view, the advantage of ease of movement *within* the opposing lines should evidently rest with the defender, whose interior communications can be perfected in peace-time.

The lateral communications of the besieger are, at the outset, such only as the defender has chosen to accord to him. All the rest he must make for himself, and make under fire, except where they are so far in rear as to be beyond the possibility of observation from balloons, raised observatories, or advanced posts. The defender can, at leisure, create a system specially designed to meet all requirements, fully screened from view and protected from fire.

For radial communications the besieger must rely mainly on the roads and railways converging upon the position, which may be interrupted in various ways before the investment. The defence, on the other hand, may possess a ready-made system conforming precisely to its tactical needs, effectively linking the main line to the depots of supply, and conferring upon the Artillery a mobility with which the besieger cannot attempt to compete.

Communications are, however, less showy than towering scarps, appeal less to the non-military eye, and have consequently been frequently neglected in favour of matters infinitely less important.

In the Fortification of the future, roads and railways, permitting the free and rapid movement of men, guns, and stores within the line of defence, must receive a prominent place. Thus will the defender be able to gain and retain to the last the power of surprise, not merely in the sense of delivering counter attacks, but in suddenly and unexpectedly developing a crushing local superiority of Artillery fire from which great results are attainable. The full power of fortress Artillery, well handled, scientifically distributed, and completely organized, has never yet been even approximately realized in siege warfare.

In the preparation of the foreground and the treatment of the position itself, a wide range of possibilities awaits utilization by the defence—possibilities which permanent Fortification, absorbed in caponiers and drawbridges, has frequently either neglected altogether or regarded as of minor importance. The difficulty of breaking through an investing line once thoroughly established is generally admitted, and the "retaining power" of the modern rifle is, in this sense, recognised.[1] Such advantages, however, as the besieger possesses in the preparation of his position are enormously exceeded by those at the disposal of the defender, who can plan his works deliberately, with time, labour, and material unstinted.

The arbitrary division of the science of Fortification into two so-called branches—Field and Permanent—has much to

[1] "The besieger can make his first positions, with their slight inconspicuous earth-cover and obstacles, almost unassailable."—"Studies in Fortress Warfare—the Defence." Translated from the German by the writer. R.E. Professional Papers, vol. x.

answer for. The one passes by imperceptible degrees into the other. The greater includes the less, which is its necessary adjunct—not its subordinate—and permanent Fortification does not begin and end in the building of a few monumental forts encircling a mediæval *enceinte*.

The besieger could not at any period grow a strong hedge or a tract of thick brushwood, still less a belt of wood. The two former can be utilized to create highly important tactical features over the terrain of a fortress. The latter, judiciously placed, may be invaluable to screen movements within the position, or to serve as a defensive line. The edge of a wood hastily prepared for defence is fully recognised in text-books of field Fortification as capable of being strongly held; but, if the preparation has been deliberate and complete, if the flanks are guarded by Infantry redoubts, and if the communications to the flanks and rear are perfect in conception and construction, the tactical value of a wood is enormously enhanced. Used merely as a visual screen, trees well disposed confer great advantages upon the defence, since to be hidden from view under most circumstances suffices for protection. Finally, both trees and brushwood can be most effectively employed to mask works of defence; but this entails careful study on the ground, and can neither be dealt with in the drawing-office nor expressed in diagrams.

The great value of obstacles is now recognised, and forms the subject of much discourse in text-books of field Fortification. In permanent Fortification, however, they have been commonly swallowed up and lost in the portentous ditches, which used to be regarded with all the blind reverence of superstition. Permanent Fortification can, however, utilize obstacles to an extent wholly impracticable in field defences. Entanglements may be employed without stint, and can be well covered and rendered infinitely more formidable than

the light wire and wooden picket arrangements which represent the maximum attainable by a field army. Unclimbable iron fences, sunk and practically invulnerable to Artillery fire, while impassable and inaccessible under the rifle fire of the defence, can be provided without difficulty. Natural obstacles, formidable both to forward and to lateral movement, can be grown in profusion. Land mines can be freely utilized, and are capable of producing both moral and material effect. All these things are much more than adjuncts to permanent Fortification. They are of its very essence, and will be realized as such when the older ideals have been relegated to the history of evolution.

Ditches and caponiers are now no longer required to enable an assault to be repulsed with ease. They can play no defensive part till the last stage of a formal attack, and so soon as the besieger has established himself securely on the glacis and can begin mining operations, they are worse than useless. Counter-mining actively carried on may delay him for weeks; ditches and caponiers, however heavily clothed in iron, will quickly yield to mining if it is necessary to deal with them.

Turning to the more special features of Fortification proper, certain changes are inevitable. Permanent *enceintes* will find no place in the land Fortification of the future. Antwerp is the only "*grand pivot stratégique*" built since the introduction of rifled guns which has received this so-called "*complément de défense*," and its destruction has for some time been under consideration. In our own case, the lines of Portsmouth and Gosport have long disappeared, having become obviously useless on account of the growth of buildings outside them. The land front of Valletta, however, retains two elaborate *enceintes*, of which the inner is wholly valueless, if not disadvantageous, while the outer would be improved by being simplified

and shorn of its technical adornments. The expense involved is, however, a serious consideration.

Two distinct rôles have been claimed for *enceintes*. In the first place, they are supposed to prevent the rush of an enemy through the intervals in a line of forts and the capture of the interior of the position by a *coup de main*. In the second place, they are to serve the purpose of a retrenchment, prolonging the defence after the main line has been breached by the fall of one or more of the detached forts. Military history and common-sense support neither view.

It has sometimes been gratuitously assumed that the *enceintes* of Paris and Metz alone prevented the Germans in 1870 from passing the forts, notwithstanding that to have involved an army in street fighting with a line of intact positions in its rear would have been simply suicidal. A curious light is thrown upon the real *raison d'être* of the *enceinte* of Paris in "The Memoirs of Count von Beust,"[1] where it is stated that in 1840 M. Guizot demanded and received "large concessions from the Chamber for the purpose of surrounding Paris with a number of forts, to which a circular wall, an '*enceinte continue*,' *had to be added, that it might not appear to the people that Paris was to be bombarded during a riot*." This was certainly political Fortification in an extreme form, and the Nemesis of history followed thirty years later in the bitter resistance which the Commune was able—thanks to M. Guizot's *enceinte*—to offer to the troops of Versailles.

A line of permanent forts can be rapidly retrenched by field redoubts as soon as the front of attack is declared, and, given supplies, *moral*, and advantages of ground, the defence can thus be prolonged; but no *enceinte* can now hope to offer any further resistance on its own account. Capture the main line, drive the defenders into the town, depriving

[1] Edited by Baron H. de Worms, 1887.

them of the open ground necessary to movement in organized masses, and a Sedan inevitably follows.

The disappearance of the *enceinte* is a natural result of the evolution of Fortification. As soon as the power of Artillery made a distinct advance, the occupation of a hill commanding a town became desirable. The primeval wall no longer sufficed in such a case, even when it had been exchanged for one of Vauban's terraced mazes. Hence, at an early period, arose detached forts such as Christoval at Badajoz, and St. Michael at Burgos. The introduction of the rifled gun at once necessitated a further extension of the line of defence. Common-sense, the principles of tactics, and considerations of expense, dictated a chain of detached forts for the line thus extended, although the building of a Chinese wall as the main line of defence of Paris found advocates in 1840, and the same principle was again put forward in this country so late as 1880.[1] The chain of forts was, however, in numerous cases applied to encircle towns already possessing venerable *enceintes*, and by a confusion of thought the latter came to be regarded and to be upheld as an integral part of systems of defence.

A similar influence to that which caused the retention of the *enceinte* has operated in the conservation of the reduit as a necessary or desirable adjunct to a detached fort. The fortified towns of the Marlborough period almost invariably possessed a citadel,[2] in which the garrison, having abandoned all that the works claimed to defend, were to lock themselves up, and either stand a second siege, or, having refreshed and reorganized themselves, to sally forth and retake the town. Although, for obvious reasons, this plan of defence rarely succeeded, the diagrammatic possibilities which the citadel suggested were too fascinating to resist,

[1] See a paper by Major Parnell.—R.E. Occasional Papers, vol. iv.

[2] See plan of Lille, Plate I.

and the reduit—its lineal descendant—was imposed upon the detached fort, and soon came to be preached as a necessity. The result has been occasionally ridiculous; the keep, originally intended to be the last resource of the defence, being designed—at Fort Tregantle, Plymouth, for example—so as to ensure priority of destruction from the Artillery of the attack. Once permit a principle of art to pass into a convention, and the grotesque is quickly evolved.

General Brialmont was one of the last champions of the reduit,[1] and an examination of the reduits which he proposed suffices to ensure their condemnation. Fig. 2, Plate XXI., is a section through one of these keeps, which is simply a symmetrical mound culminating in a single cupola, surrounded by an infantry parapet and enclosed by a circular ditch, with both scarp and counterscarp galleries supplemented by a caponier, *A*, surmounted by a mediæval *guérite* tower. The *chemin des rondes*, *B*, carried all round the keep, appears to be peculiarly useless. The mound itself is a species of ant-heap, containing casemate accommodation, magazines, and stores.

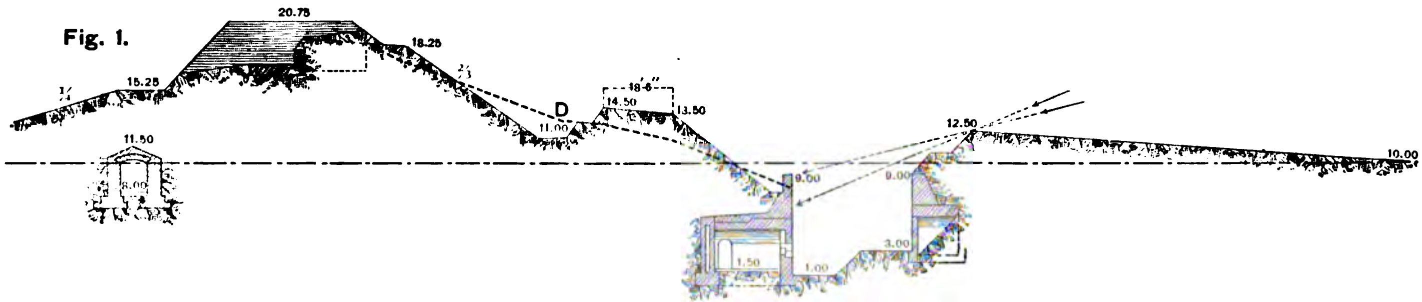
After a few hours' bombardment by heavy shells, this so-called keep would become a shapeless mass of earth, the section taking the form shown by the dotted line. The Infantry parapet would be levelled, and the garrison ensconced below would, if they ventured to emerge by their trap-door, *C*, find no cover and reap no advantage whatever. The temptation to emerge, in order to spread out over a tumbled slope turned towards the enemy, would not be strong, and nothing could suit the purposes of that enemy, after he had mined the scarp, so well as to find the greater part of the garrison buried in underground chambers with few points of egress, which could be effectually sealed by two

[1] "La Fortification du Temps Présent."

PLATE XXI.

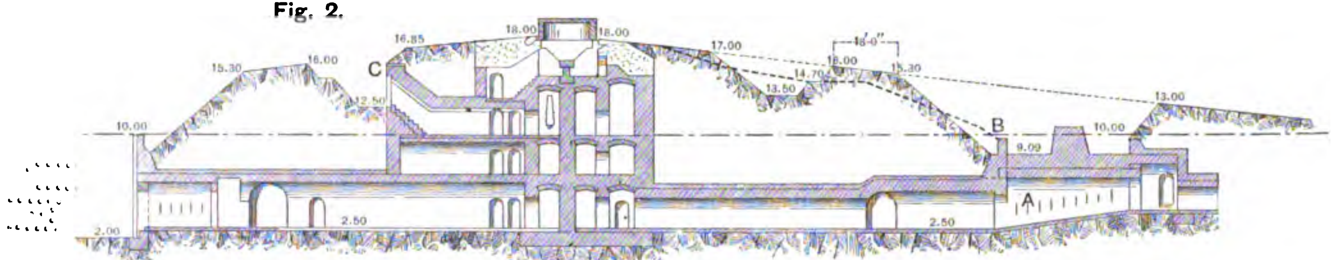
DETAILS OF TYPICAL FORT.
(BRIALMONT.)

Fig. 1.



SECTION THROUGH FRONT FACE.

Fig. 2.



SECTION THROUGH KEEP.

Scale of Metres
0 5 10 15 20 25 30 35 40 45 50

To face page 136.

or three men with revolvers. Even if the single cupola remained uninjured, and could fire occasional rounds it would be quite incapable of clearing the main work.

Some years ago, however, the French manual condemned keeps, while Von Sauer and other German writers held that the siege of Paris alone served definitely to kill this survival of the past. The drawbacks involved—complication, size, the undesirable depth of the work, bad interior communications, and expense—are evident. The first requisite of a fighting position is simplicity of conception, and the vagaries of drawing-office Fortification may be positively dangerous.

The section shown in Fig. 1, Plate XXI., is that of the front faces of one of General Brialmont's designs, and is open to great objection. The two-decker arrangement, with the Artillery in the upper tier, precludes the manning of the lower Infantry line while the guns are in action. The two-third slope close in the rear of the Infantry line *D* would render it untenable under Artillery fire, since all fairly accurate shell would be caught and burst at the men's backs. This species of trench, to which the whole of the Infantry defence of the fort is confined, would be partially filled in and wholly knocked out of shape (as shown by the dotted line) by the shell fire of the attack, and would require constant reconstruction. To work on a slope turned toward the enemy is a hazardous operation even by night, while the cessation of the Artillery fire of the upper rampart would further be entailed. Finally, it appears that the only access to the Infantry line—about 120 yards long for each face—is at the salient. The time and difficulty of filing the men out of narrow and dark underground passages, and spreading them along the line that they are intended to hold, or of getting them under cover again when the besieger's Artillery opened fire, may easily be imagined. All such considerations, however, have frequently been ignored in the drawing

office, where symmetry of plan counts for more than military fitness.

One of the most important considerations with respect to a fort—regarded as a fighting position and not as a geometrical puzzle—is the necessity for simplicity of arrangement and conception. The first military essential is the possibility of retaining general control over the garrison, of being able to get men rapidly into position when and where wanted, and of duly supervising them, especially under fire.

Notwithstanding that the inadequacy of systems of Fortification into which iron protection does not largely enter has been loudly proclaimed by a certain school, regular sieges are naturally regarded with disfavour. The speed of the progress of events in a modern European war is incompatible with a Sebastopol, almost with a Plevna. It is realized that Paris and Metz only needed resources to have enabled their resistance to be greatly prolonged. Modern impatience of results is staggered by the prospect, and hence arose a school in Germany which loudly demanded assaults *de vive force*. The French fortresses of to-day are a formidable fact which cannot be ignored in any future Franco-German war, although some French writers appeared for a time to be so seriously afflicted with high explosives on the brain as to decry the defences on which vast sums have been spent. Provided that these fortresses are properly equipped, that proper garrisons are available, and that officers qualified to command exist—all of which conditions were wanting in 1870—great and costly efforts would be necessary for their capture. The *vive force* school proposed, therefore—on paper—to shell them heavily and then storm, trusting to incomplete organization and general unpreparedness.

There is little or nothing in military history to bear out the views of this school, and modern experience is entirely

against them. Only one such attempt was made in 1870-71 —against the indifferent provisional works of Belfort, garrisoned mainly by *gardes mobiles*[1]—and this failed completely. The tremendous assaults on the defences of Port Arthur may have been partially inspired by the German teaching; but the results were discouraging, although the devoted and sustained gallantry of the Japanese could not be surpassed and probably would not be equalled by any European army.

If, however, such a method of avoiding the delays of a siege is ever to prove successful, the forts which were designed by General Brialmont would be well calculated to reduce the difficulties of the assaulting force. A work designed on the principles of the Roman catacombs is suited only for the dead in a literal or in a military sense. The vast system of subterranean chambers and passages is capable of entombing a brigade, but denies all necessary tactical freedom of action to a battalion. The mere lighting of the underground communications throughout a long period would be a serious matter. To maintain any proper grip over the garrison will be almost impossible, and unless it is composed of heroes, the difficulty of getting the men to the front when wanted will prove almost insuperable. No conditions can be more utterly unsuited to short-service armies. Even with supreme discipline and long and careful training, it is no easy matter to retain full hold over a ship's company in action; but a ship, as a fighting position, is a simple affair compared to one of these forts, which conform as little to the requirements of war in conception as in detail.

The "rare perfection" of the lines of Mainz in 1795 affords ample explanation of the fact that a garrison of 30,000 French troops surprised by two weak detachments

[1] Les Perches Redoubts. See Plate VIII.

was thrown into a "disorder that nothing could remedy."[1] If these lines had conformed to the primary conditions of a fighting position, which they probably might have done at one-tenth the cost, the weak detachments would, doubtless, have been annihilated. The garrison was lost by its own defences. The defences of the future must, on every ground, conform to tactical requirements in the smaller as well as in the larger sense.

One point remains to be noticed. It is sometimes assumed that by the subterranean elaboration of defensive works, or by splitting up the garrisons into driblets and putting them behind armour, a great saving in *personnel* may be effected; and, further, that by increased expenditure upon Fortification, inferior and half-organized troops may safely be employed. These are only specious pleas in vindication of technical extravagances. The necessary strength of garrison is ruled mainly by the length of line to be defended. Major (now Colonel) Lewis, R.E.,[2] basing his calculations on rational grounds, arrived at the conclusion that for a perimeter of 45,000 yards defended by nine forts the garrison should be about 28,000 men, *exclusive of the garrisons of the forts.* Thus the permanent defences play a relatively small part in the calculation, and this must always be the case whenever a long line must be occupied. The large garrisons now required are necessitated by the conditions of modern war, which have necessitated wide extension, and neither cupolas nor technical elaboration will enable us to reduce them.

Nor is the garrison of the entrenched camp of to-day really greater than that of the old Vauban fortress. Plevna, it may be said, made a memorable defence in spite of its extemporized works, because it held a Turkish army; but

[1] See p. 21.
[2] R.E. Occasional Papers, vol. i., 1877.

Osman Pasha's garrison provided less than one man per yard of the whole perimeter, and not more than three men per yard were available for the defence of the front of 7½ miles attacked by the Russo-Roumanian army on the 11th September, 1877. Strasburg, with a full equipment of ditches, ravelins, counter-guards, etc., had in 1870 a garrison providing about two-thirds of a man per yard for the whole perimeter, and three and a half men for the front attacked. Thionville, with an elaborate bastioned *enceinte* by Vauban and Cormontaingne, had a garrison of two-thirds of a man per yard, and made a resistance of eleven days. Paris, in September, had about three and a half men per yard (later about seven), Metz five and a half per yard, and either would have made a longer defence if its garrison had been reduced by more than one half. On the other hand, Badajoz in 1812 had about one man per yard, and made a resistance of thirty days. Port Arthur could not have been held with the permanent garrison allotted to it (p. 109), but the large field forces left behind by Kuropatkin provided a *personnel* as numerous as the available supplies justified, and a further increase would not have added materially to the duration of the siege.

It is fully admitted that these figures give no really satisfactory standard of comparison where other conditions necessarily differ; but they inculcate caution in assuming that technical refinements of Fortification can be substituted for troops. Even if M. Mougin's preposterous subterranean fort (Plate XVI.) could be accepted as the basis of the permanent Fortification of the future, it would be found that the total garrison required for an extended position thus defended will not be affected by the substitution of mechanics for soldiers.

If the standard of Fortification adopted is such as to render an assault hopeless—and this standard is now easily

attained—no further elaboration of design, no extravagant employment of armour, will enable a reduction of garrison to be made. It must be remembered, however, that an effective defence in the present day makes far more exacting demands upon the organizing powers of commanders and the quality of the troops than in the past, and that raw levies are now less than ever suited to the task.

CHAPTER XI

STRATEGIC CONSIDERATIONS—USES OF FORTIFICATION—FUTURE EMPLOYMENT

Reviewing the history of war as a whole, it is clear that the achievements of permanent Fortification have been capricious and frequently disappointing. Fortresses on which large sums and much thought had been expended have proved incapable of the resistance expected by their designers; or they have been in the wrong place, and were, therefore, unable to play the part contemplated for them in strategic conditions which did not arise. Nevertheless, the defence undoubtedly gained in the local and restricted sense by the introduction of firearms, and has relatively increased in strength with their development. Thus, whenever the circumstances were moderately favourable, works of simple form and constructed *ad hoc* have served their purpose with marked success, while masterpieces of the art of the engineer have palpably failedf

The reasons for this apparent paradox have been indicated in preceding chapters, and if the Fortification of the future is to be scientifically ordered, it is necessary to find means of avoiding the waste and the misdirection of effort of which the past provides innumerable examples.

Permanent Fortification, which implies defensive works deliberately planned and constructed in peace-time, must—as a cardinal principle—be employed only in accordance

with a definite scheme of national policy. Otherwise it will necessarily be useless, and possibly harmful, since it may, as has happened in this country, serve to warp that policy. As national policy, however it may vary with changes of circumstances, must be based upon considerations which have nothing to do with Fortification, the question, 'What useful purpose can be effectively served by permanent works of defence?' at once arises, and clear thinking at this stage is pre-eminently desirable.

Thus, it should be realized at the outset that all fortresses must fall if sufficient force is brought to bear against them, and that the only function which Fortification can discharge is to gain time, locally or generally. Time so gained is valuable only if—

(1) The fortified State possesses resources which can be effectively developed and organized during the period of delay; or

(2) The resources of the invader can be exhausted in the process of attempting to capture the fortifications, so that the balance sways to the side of the invaded. In this case, if the exhaustion of the invaders is complete, the tables may be turned upon him, or he may be induced to make a disadvantageous peace in fear of being attacked.

It may, therefore, be laid down as an axiom of war that Fortification, whether inland or on a seaboard, whether permanent or temporarily created, will, in the strategic sense, prove advantageous to a State only by reason of the operations which, sooner or later, can be undertaken by field armies or by sea-going ships outside its *rayon*. This may seem to involve a conflict of ideas; but the time gain, which is the only justification of works of defence, is valueless unless it can be turned to account, either directly or in the form of menace.

If a State is strong enough to assume and to maintain a

general offensive in the field, Fortification on its territory can play no part. This was the case of Germany in 1870; but since no nation dares to trust its power of waging a wholly offensive war in all circumstances, the aid of Fortification must continue to be invoked. Moreover, an offensive plan of campaign may demand the delaying action of Fortification on one portion of the frontier while the attack is directed from another portion.

The rôle played by the French fortresses in 1870-71 was marred by technical defects and a general want of organization, but their delaying action was manifested in varying degrees. As has been pointed out (Chapter VI.), some of them exceeded reasonable expectation in this respect; but, in spite of the gallant efforts of the French people, the resisting power of Metz and Paris did not suffice to give the time necessary to bring the resources of the nation into full play; nor did the heavy strain upon the invaders reach the breaking-point.

Most of the French fortresses were built before the era of railways, and their distribution and relative strengths were not suited to the requirements of the war. If they had been well supplied and completely equipped, their delaying power might have considerably increased; but, even in this case, they could have saved the situation only if the French succeeded in creating armies capable of defeating the Germans in the field. Prior to 1870, the traditional military policy of France in relation to Germany had been offensive, and this may account for neglect of defensive preparations, the need for which was not recognised, in spite of the warnings of Colonel Stoffel.

Looking to the future, Fortification will probably be restricted (1) to frontiers; (2) to a few interior strategic points, mainly important railway junctions, or the crossing-places of great rivers; and (3) to capitals or other

towns the capture of which might cripple the fighting power of a nation. Much has been loosely written as to "pivots of manœuvre," "*places d'armes*," or "fortified regions," serving as supports to field armies, and it is necessary to remember that a fortress, as such, can protect only a fixed and limited area. It may provide a base of supply for field forces, whose influence upon a campaign will depend entirely on their fighting efficiency, their numbers, and their mobility. If valuable field troops are allotted to fortresses, the main armies are *pro tanto* weakened. On the other hand, fortresses conveniently near to the theatre of war have frequently exercised a baleful influence upon armies deficient in *moral* or suffering from a reverse, and nations in their decadence have generally resorted to Fortification on a large scale. The fewer permanent works a State creates the better, provided that reasonable strategic requirements are met, especially since formidable defences can be created in a short time, capable of offering prolonged resistance if adequate supplies can be made available. It may be laid down as a general rule that no place should be fortified unless an enemy would have powerful reasons for wishing to occupy it.

Fortification has usually been regarded as a compensation for inferior fighting power. "Throw up earth," wrote Napoleon to Lefébvre, and he has recorded the opinion that "with mediocre troops it is necessary to throw up much earth." This is a doctrine to be received with caution. Silistria (1854), Kars (1854), and Belfort (1870-71) are instances of good defences made by ill-trained troops; but in all these cases the garrisons were composed of fighting races, and were exceptionally well commanded. In future the demands upon fortress garrisons and their commanders will tend to increase, and mediocrity will rarely suffice. Half-trained and undisciplined troops would never have

withstood the terrific assaults of the Japanese on Port Arthur.

It is frequently claimed that Fortification enables men to be dispensed with, and this is true in the sense that, given equal fighting capacity, a much larger force will be required to attack than to defend a fortified position. Modern weapons, combined with telegraph and telephone communication, have, however, added materially to the containing power of an investing force, and if an attack is not necessary, it will frequently happen, as at Metz,[1] that the smaller numbers can neutralize the larger, which may be hampered in breaking out by their own defences, or partly demoralized by the sedentary rôle which they have assumed. A Japanese force considerably smaller than that of the Russians could have held the latter securely in the Liao Tung Peninsula, if it had been decided not to attack Port Arthur.

The fortification of a frontier may take two forms:

1. Large fortresses, such as Metz or Verdun.
2. Barrier forts, such as have been constructed in the Alps.

In both cases, the defences would be so placed as to bar important lines of communications—railway, river-bridge, high road, or mountain pass—but their functions would differ. Thus the frontier fortress, it must be assumed, would not only provide a passive obstacle, but would serve as a base for mobile forces capable of cutting the communications of an invading army which had passed it, or of com-

[1] The topography of the ground inside the defences of Metz was unfavourable to breaking out; but the higher leading of Bazaine's army was distinctly incompetent. Moreover, the restricted area within the defences of a fortress can rarely provide adequate means for the reorganization of a beaten army, or for the creation of an army out of untrained levies, especially when it includes a great city. This was clearly shown at Paris in 1870, where the task of Generals Trochu and Vinoy was vastly complicated by political ferment.

pelling that army to detach a large number of troops to guard its rear. If the invader has greatly superior forces, the fortresses, if far apart, will be limited to the function of denying the lines of communication which pass through them. Their value will thus depend upon the importance to the invader of these lines, and their delaying power will only come into play if he is forced to attack them. In the case of a long open frontier, therefore, either a multitude of fortresses would be required, or the fortresses would be grouped so that certain sections of that frontier would be barred until siege operations had been carried out, while gaps would be left in, or in rear of which the field army of the State which contemplated a defensive strategy could be massed. On the other hand, the barrier fort must generally depend upon its own resources, becoming thus practically a passive obstacle.

The fortified State which contemplates being invaded must decide whether to fight in advance, or on the line, of its frontier fortresses. In the former case, the fortresses will have no influence upon the issue of the first battles, but may, as depots of stores, etc., assist mobilization. The latter course would, therefore, commend itself to a State which must oppose the invaders with inferior forces, or has no confidence in the completeness of its preparations.

The theory that fortresses are desirable in order to supply convenient places for the retreat of beaten armies is well calculated to enfeeble strategy, and to bring about the situation it contemplates.

In a passage which deserves to live until wars have ceased, Gibbon has stigmatized the misuse of Fortification in the case of the decadent Empire of Rome :

The fortifications of Europe and Asia were multiplied by Justinian but the repetition of these timid and fruitless precautions exposes, to a philosophic eye, the debility of the Empire. From Belgrade to the

Euxine, from the conflux of the Save to the mouth of the Danube, a chain of about four-score fortified places extended along the banks of the great river . . . a strong fortress defended the ruins of Trajan's bridge. . . . The Straits of Thermopylæ, which seemed to protect, but which had so often betrayed the safety of Greece, were diligently strengthened. From the edge of the seashore through the forests and valleys, and as far as the summits of the Thessalian mountains, a strong wall was continued which occupied every practicable entrance; granaries of corn and reservoirs of water were provided for the garrisons, and by a precaution which inspired the cowardice it foresaw, convenient fortresses were provided for their retreat.

Great Britain has only two land frontiers which have suggested ideas of Fortification, and both are, for different reasons, exceptional. If it were conceivably desirable to attempt to fortify the 3,000 miles of the southern border of Canada, Fortification, whether in the form of the French fortresses, of the Chinese Wall, or of the South African blockhouse lines, would be equally impracticable. Nature has done her utmost for the defence of India by erecting a stupendous mountain barrier on the north, and by interposing hundreds of miles of barren or desert country between the north-west and any possible invader.

The theory of the fortifications of Quetta is, therefore, difficult to grasp, and probably no other fortress has ever been erected to oppose a possible enemy whose nearest territory was more than 500 miles away, the intervening country being unable to supply a large invading army with food or water. As Quetta could not be attacked in great force for at least eighteen months from the outbreak of war, the idea of waiting behind its ramparts while preparations were in progress appears untenable. If in eighteen months we could not take the field, is it probable that we should do so later? On the other hand, if Quetta is intended as a base for an attack on the flank of an army which after a long period of railway construction is seeking a passage of the Suleiman range to

the north—in other words, if our strategy is to be offensive—slight defences sufficient to protect the resources there accumulated against tribal raids would evidently suffice. If, like the fortresses of Justinian, it is designed to shelter a beaten force in face of a victorious enemy, it appears well calculated to become a trap. The divorce of Fortification from any clear military policy could not be more aptly illustrated.

Of barrier forts Great Britain possesses none, since such places as Ali Musjid or Landi Kotal are only intended to resist a tribal attack.

On the Continent, strategic points in rear of the frontier must generally be associated with railways, the use of which is essential for the supply of a large invading army. Thus, great railway junctions or points at which main lines cross broad rivers will frequently possess sufficient strategic importance to justify Fortification. The network of lines is, however, now so dense in most European countries that detours are possible without inordinate loss of time. Moreover, our excellent work in South Africa shows how much can speedily be accomplished in restoring broken railway communication.

The great fortified positions at Liége and Namur are examples of defended river crossings. The term "entrenched camps" was denied to them, and they were officially defined as *têtes de pont*. In the words adopted by the Belgian Government, "*Les têtes de pont dont il s'agit ne peuvent être confondues avec des camps retranchés. Ce sont des simples pivots de manœuvre, des places d'arrêt.*" The distinction between the *camp retranché* and the *pivot de manœuvre* appears to be academic, both implying the existence of a field army which is intended to be employed outside the defended area. Considering the very large extent of these positions—respectively about thirty and twenty-four miles in circumference

—the term *places d'arrêt* seems inappropriate, since, as pointed out (p. 116), the forts alone would not be able to arrest an attack, and a considerable field force would be indispensable for security. On the other hand, this field force would be able to be transferred to whichever bank of the Meuse was threatened, the encircling works—in this sense—serving as a double *tête de pont*. Failing the provision of an effective field army, it is difficult to assign any useful strategic function to these extensive fortifications.

The promiscuous fortification of towns, which was common in the Middle Ages, and extended to the time of Vauban, is no longer in vogue. It arose in days before great States became consolidated under a central Government, and when armies were not mobile in the modern sense. A town, once fortified, easily came to be regarded as a place which it was necessary to defend, and this habit of thought has not wholly disappeared.

The strategic importance of a capital must depend upon its relation to the political and economic life of a nation, and will, therefore, vary according to circumstances. There will, however, generally be a popular demand for the fortification of a centre of national activity, and if the machinery of governments continues to grow more and more unwieldy, the strategic importance of capitals as decisive objectives will increase.[1] At the same time, the huge area which the modern capital occupies must add greatly to the expense and difficulty of Fortification, while the supply of a population of several millions during an investment or a siege may prove an insoluble problem.

A Power which is compelled to contemplate being invaded across its frontier, and which desires nevertheless to use

[1] In the case of States, such as the Transvaal in 1899, where the social organization is of simple form, the occupation of the seat of Government may have little or no military importance.

its navy offensively, will fortify the land fronts of its naval arsenals, which may become strategic points of first-class importance. The Crimean War is a striking instance of the concentration of effort upon such an objective. The conditions were, however, exceptional in certain respects, and the exhaustion of a great State by attacking an almost insular extremity is most unlikely to be repeated.

The use of Fortification, whether of field or of permanent type, does not imply a resort to defensive tactics or strategy. Armies continuously operating on the offensive, like those of the Japanese in Manchuria, will nevertheless resort to field defences on a considerable scale, especially when their superiority of numbers is not marked. In this case they will seek to obtain the advantage of the delaying power of Fortification, so as to be able to detach troops for operating against the enemy's flanks or rear. Similarly, a great military State, even if it counts upon bèing able to take the offensive at the outset of war, will not disdain permanent Fortification employed with a view to delay the possible enterprise of an enemy against certain sections of its frontier. The value of the defences will be greatest if their sites have been selected in conformity to a well-considered national policy, but must, in any case, depend ultimately upon operations in the field. Success in war will now, as always, be determined by the action of seagoing fleets and field armies, which should be the first consideration of the statesmen to whom the security of nations is entrusted. No amount of expenditure upon Fortification can compensate for the neglect of either.

CHAPTER XII

CLASSIFICATION OF DEFENCES—INFANTRY REDOUBTS—ARTILLERY POSITIONS — INVISIBILITY — COMMUNICATIONS—ELECTRIC LIGHTS—ORGANIZATION—ADVANCED POSITIONS

THE ground has now been cleared for the foundations of the Fortification of the future. The principles of defence are simple ; their application is capable of being understood by any educated soldier. By exaggerating the mysteries of the science, the sense of proportion is dulled, and real military requirements tend to become obscured in futile tricks of design. No other explanation can be suggested which will account for the failure, under the test of war, of elaborate permanent forts as compared with rude defences conforming more nearly to tactical needs ; for the obvious shortcomings which any careful examination of most of the costly works of the schoolmen discloses ; or for the fact that, after vast sums have been swallowed up in excavations and brickwork, the essentials of a fighting position have been frequently found wanting. Organization, capable commanders, efficient armaments, adequate supplies, matured preparations, well-arranged communications—these conditions are the essence of the defence, and must determine the resisting power of land Fortification. Within broad limits the details of design are of relatively small account.

No attempt is, therefore, made to lay down rigid types or to

apply geometrical forms inapplicable to ground which is not featureless. The idea of designing permanent works in an office with the aid of a contoured map as sole assistance must be abandoned. It has hitherto been the great advantage of works constructed in the field that they have been planned on the spot, and have, therefore, conformed to tactical requirements.

In the permanent Fortification of the future, the same process must be adopted. The ground must be thoroughly studied from the point of view of the attack as well as of the defence. Self-advertising works will then cease to be created, and linear methods being discarded, the main object will be to blend the works into the landscape. With care this object can always be attained; but far more thought and study are required than were involved in plotting on a drawing-board the elaborate traces of the so-called "modern French" or "German" systems.

Future defences will divide themselves naturally into the following categories:

1. Permanent works wholly constructed in peace-time and forming the key-points of the position.

2. Gun emplacements, magazines, and shelters for men in rear of the main line, all concrete structures and platforms to be completed, though some earthwork may be left until the position is placed in a state of defence.

3. Field works, trenches, etc., guarding the intervals between the permanent defences in the main line, or providing rear positions. These should be deliberately planned in time of peace ready to be put in hand at short notice.

The essence of a well-fortified position is that the weapons of the defender shall obtain the utmost possible scope of action, and that those of the attacker shall have the

minimum chances of effecting injury. To secure a full development of rifle fire from men well covered will, therefore, be one of the first objects, and the power of the modern small arm abundantly supplied with ammunition is now so great that the immediate frontal field of fire need not be widely extended if the natural features of the ground do not permit. Provided that there is an effective obstacle, the density of fire which a line of men 4 or 5 feet apart can deliver is capable of stopping the most determined attack. It will usually be better, therefore, to choose a site behind the brow of a hill, if a good field of fire about 300 yards in depth is available, than to occupy the brow itself, where the slope in front is steep. Moreover, the fire from adjacent works, or from guns in rear of the main line, may effectively cover the restricted foreground. The concealment of the works themselves will also be promoted. A "commanding position" may, therefore, not be necessarily well suited for the site of a permanent work.

Similarly, as the Artillery of a fortress must depend mainly upon indirect fire, visual command is more important in the case of the observing station than in that of the gun. The general principle, strongly advocated by the writer more than seventeen years ago, that the Artillery armament should be kept outside the permanent works, was strikingly affirmed at Port Arthur, and is now generally accepted. It will follow that the Artillery of the defence can be left free and unfettered in the choice of concealed positions. On the other hand, the ordnance of the besieger, if its fire is concentrated on the permanent Infantry redoubts, will, for the time, be unable to deal with the Artillery of the defence. The general idea is, therefore, that the latter, guarded against assault by Infantry fire, shall be distributed mainly with a view to (1) concealment and (2) concentration upon the best Artillery positions which the terrain of

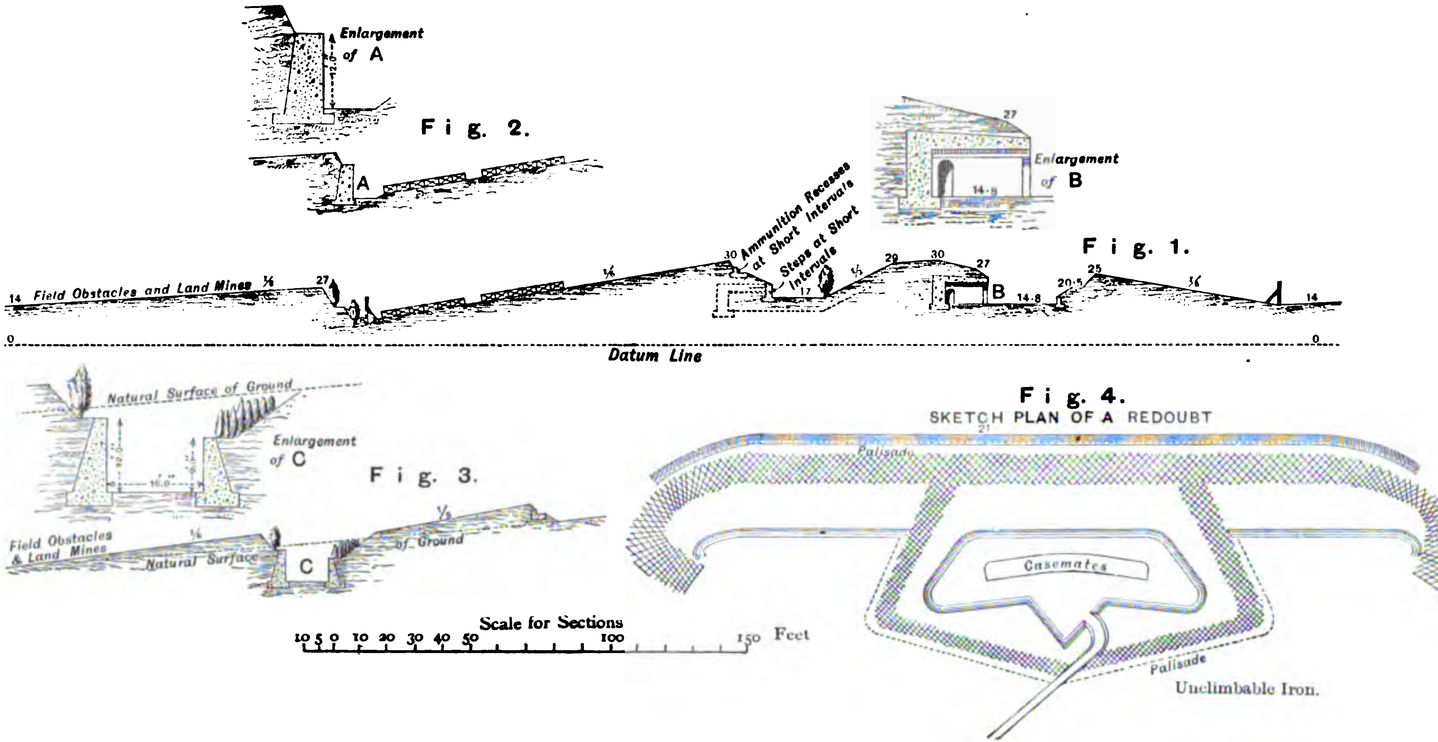
the fortress offers to the guns of the besieger, which also will be concealed as far as possible.

In selecting the sites for the permanent Infantry redoubts the considerations are purely tactical. What points in the general line of the position is it specially desirable to hold ? Having regard to the foreground, what points lend themselves best to defence by Infantry in permanent works provided with substantial obstacles sufficient to render direct assault hopeless, and to force the besieger to undertake formal siege operations preparatory to mining ?

Infantry Redoubts.

Plate XXII. indicates an Infantry redoubt of simple form the trace of which can be adapted to the ground, and would generally assume curved form. Alternative sections are shown : a glacis with permanent obstacles and an unclimbable iron fence in Fig. 1, a counterscarp replacing the fence in Fig. 2, a reveted (or rock-cut) ditch in Fig. 3. The natural features of the site would determine the form of section to be adopted. Stiff hedges entwined with barbed wire can be employed in connection with Sections 1 and 2. Shelters are introduced under the faces of the redoubts, and also under a parados. The latter should have an overhead thickness of about 6 feet of concrete. For the former, which will have small depth from front to rear, about 3 feet 6 inches should suffice. If the merging of the work into the landscape has been successfully carried out, it may not be necessary to traverse the flanks, which, like the front face, will often take a curved form. Such a redoubt should have a garrison of 350 to 400 men, and shelter should be provided for at least three-fourths of this number. By abandoning the attempt to combine a fort and a barrack, the comfort of the garrison will be sacrificed to some extent ; but the conditions can be made greatly superior to those

TYPICAL REDOUBT.



[To face page 156.

of the besieger, which is all that can reasonably be expected.[1]

While retaining the general features indicated in Plate XXII.—a good development of Infantry fire, substantial permanent obstacles, and shelters—variants will suggest themselves. Thus, instead of placing the shelters under a parados, they may be incorporated in the gorge. As, *ex hypothesi*, the work can be attacked from the rear only by Infantry fire, loopholes and bullet-proof entrances in connection with a substantial entanglement or unclimbable fence will afford sufficient protection. The parapet of the flanks might be lowered near the shoulders, giving cover for one or two machine guns, which might be placed in portable cupolas (Plate XIV.) for which recesses had been prepared, or mounted on tripods. The treatment of the wings would depend entirely on the ground, and they might be curved to follow a contour. It need hardly be pointed out that all attempts to equalize *déblai* and *remblai* in accordance with the principles laid down in text-books should be abandoned in the case of these redoubts. There can be no necessity to exaggerate the ditch in order to procure earth which can be more economically obtained elsewhere.

The principle of retaining closed works for the Infantry redoubts forming the key-points of the main line of defence has been adhered to mainly on moral grounds. Being capable of all-round defence, and recognised as such, they could be held even if an attacking force temporarily succeeded

[1] Under the directions of the late Lieutenant-General Sir A. Clarke, when Inspector-General of Fortifications, a redoubt of this description was constructed as part of the defences of Chatham in 1886. This work, including casemates built in concrete, was completed in thirty-one working days, and could have been much improved if it had not been desired to ascertain what was possible in a short time. It is almost indistinguishable from the surroundings at a short distance, and as subsequent experiments at Lydd proved, an immense expenditure of Artillery ammunition would be required to inflict any considerable damage upon it.

in penetrating the interval between two adjacent works. On the other hand, the Artillery of the defence would render them untenable if captured by assault after being breached by mines.

Infantry redoubts of the type proposed must generally be more numerous than the large detached forts hitherto constructed. The present average intervals are as follows :

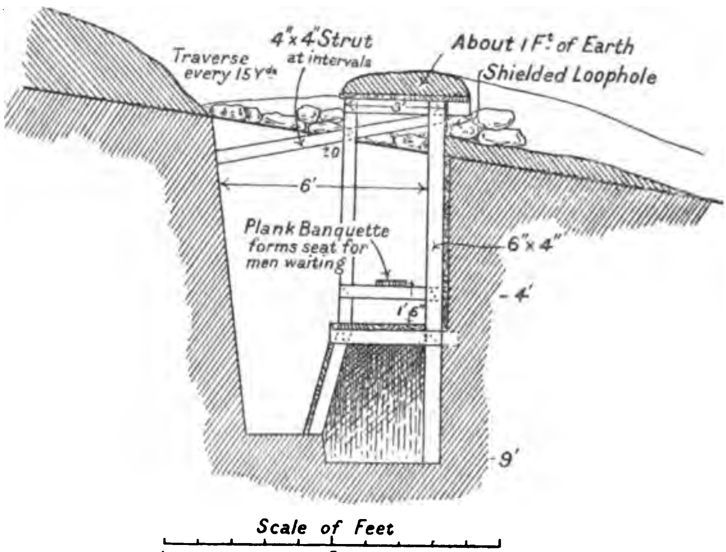
Strasburg	3,540 metres.
Cologne	3,600 „
Verdun	4,500 „
Toul	5,000 „
Epinal	4,500 „

The intervals between the Infantry redoubts may be about 2,500 yards ; but this will necessarily depend upon the conformation of the ground. Where there are good Artillery positions falling within the sphere of protection of the redoubts, larger intervals will be permissible. Thus, in the case of an extended line of defence where the ground offers marked tactical features, the idea of a continuous chain of permanent works may be abandoned in favour of groups of redoubts guarding the Artillery positions. In this case, the redoubts in a group might be distributed on a curve bent back in approximately horseshoe form.

The effective use of blinded trenches at Port Arthur suggests their adoption in permanent form. The Figure shows the section of a blinded trench in front of Tung-chi-kuan-Shan Battery, which was three times[1] attacked with the utmost gallantry by the Japanese, but could not be taken. On the first and third occasions, the storming parties, having only about 40 yards of open ground to cover, entered this trench, but were then at a disadvantage, could not work their way along it, and found retreat impossible. On the other hand, the fire from trenches on the

[1] 30th October, 23rd November, 26th November.

flank and rear effectually prevented any Japanese who made their way across the trench from shooting the defenders from the outside. Permanent trenches of this form, following the contours of the ground, might be extremely valuable adjuncts to Infantry redoubts.[1] They could easily be made fairly comfortable, and their drainage could be provided for. They might also be arranged to enable their defenders



A Russian Blinded Trench (Port Arthur).

to fire to the rear in case of need. Used in connection with good obstacles, such permanent trenches held by staunch troops would be almost unassailable.

Artillery Positions.

The Artillery of the defence having been freed from its ill-assorted union with the detached fort, considerable

[1] The use of steel bullet-proof plates to form loopholes should be noticed. There appears to be a great field for shields of this form in connection with permanent Fortification, since head-cover is now most desirable.

latitude in the choice of sites will become possible. The object being to overpower or exhaust the Artillery of the besieger, to hinder his approaches, and to co-operate quickly in resisting assault, the fullest advantage should be taken of superior convenience as regards handling, ammunition supply, observation, range-finding, communications, organization, and mobility. The marked advantages in these respects of which the defender may avail himself are of greater importance than superior shell power. A well-organized fortress can secure for its Artillery a tactical predominance which has never yet been realized.

The heaviest high-powered ordnance required is the 6-inch gun firing a shell of about 100 pounds weight. Such a piece must be mounted in a permanent emplacement if it is to be handled to the best advantage. If used for direct fire, it would probably be disabled as soon as the besieger had established his Artillery positions. Either, therefore, it should be well concealed, or it should have alternative emplacements to which it could be moved when the attack develops. A 10-inch howitzer, firing a shell of about 450 pounds weight, would also require a permanent emplacement, which, however, can be so effectively concealed as to secure immunity from all except accidental hits. All the rest of the armament should be of mobile type, and might consist of—

1. Six-inch howitzers.

2. Field guns.

3. A light howitzer (about 4-inch with a 25-pound shell), capable of being easily moved about, for use against the besieger's approaches and parallels.

4. A light Q.F. gun or possibly a "pom-pom" to hinder sapping operations.[1]

[1] The fewer types adopted the better, on account of simplicity of ammunition supply and of organization. The Russians at Port Arthur employed about fifteen types, exclusive of the coast-defence ordnance which was turned landwards. The Japanese used about ten types.

The 6-inch howitzers might be provided with permanent emplacements in sufficient number to allow of their positions being changed. Such emplacements have an advantage over siege arrangements for the purposes of controlling and systematizing indirect fire. The rest of the armament can be left out of consideration in planning the permanent works, and would fall into category (3) (p. 154).

In connection with the permanent gun and howitzer emplacements, expense cartridge magazines should be provided. These will take little space, and can frequently obtain natural protection, in the form of recesses, permanent or temporary, the cartridges being stored in damp-proof cases. Ammunition for at least two days should thus be provided for close to the Artillery positions. Projectiles can be stored under tarpaulins behind parapets in the open. The main magazines should be distributed with regard to communications with the works, and must be secure even against chance shells. A large accumulation of explosives in one spot should be avoided, and the more carefully the interior communications of a fortress have been laid out, the greater may be the dispersion. Magazines should correspond to the sections into which the defences are divided for purposes of command. At Port Arthur the Russians had three large bombproof magazines a short distance in rear of the main line of defence, and well protected by the ground (see Map).

The result of the proposed treatment of fortress Artillery will be to transfer to the besieger some of the bewilderment which has hitherto been the prerogative of the defender. The forts, which have been the usual objectives for the Artillery of the attack, will no longer provide desirable targets. It would require a vast expenditure of ammunition to injure them, and if the efforts of the siege batteries

are thus engrossed, the fortress Artillery will find the game in its own hands.

Invisibility.

For many years the writer has strongly urged the supreme importance of invisibility.[1] The advantages thus attainable have hitherto been reaped by the besiegers of fortresses; but it must be evident that a far higher degree of concealment can be conferred upon permanent works, deliberately adapted to the landscape and clothed with the local vegetation, than upon trenches newly excavated.[2] Trees and shrubs can, however, be largely turned to account for the purposes of permanent Fortification. Thus belts of trees, planted at 200 or 300 yards in rear of the general line of the position, will not only supply a background both to the Infantry redoubts and the Artillery positions, greatly enhancing their invisibility, but will effectually conceal the interior of the defender's lines, even from observers in captive balloons. Provided that good through communications are made, such belts will not impede offensive action, while their outer edges can be rapidly prepared for defence, and held by the field force as a second line if required. It is obviously undesirable and wholly unnecessary to girdle the position with a continuous line of obstacle. Wide openings must be left to facilitate offensive action. Belts of trees will, however, effectually conceal the positions of such openings from the front. In advance of the line of defence,

[1] See "Invisibility," R.E. Corps Papers, July, 1886.

[2] In 1884, during the operations in Madagascar, the French in Tamatave Fort intermittently shelled the Hova camp, doing "little damage to the defences. On one occasion only, where a Hova officer, when constructing a new work, exposed its situation by carelessly clearing the trees and exposing the newly turned soil of the exterior slope, did the French obtain the correct range for their shell fire. *The officer who committed this fault was placed in arrest and degraded in rank.*"—Captain Oliver. Similar treatment of the authors of self-advertising works in other countries would have conferred a great boon upon Fortification.

trees should be planted wherever they would impede the occupation of ground which cannot well be embraced by the observing stations and brought under fire, direct or indirect. The glacis of all the Infantry redoubts and of the intermediate works should be planted with trees, to be cut down when the fortress is prepared for defence, thus providing a great impediment to sapping, and also supplying materials for a strong advanced obstacle. When the country is treeless, local scrub growths can be turned to account in promoting invisibility or in furnishing obstacles. Such growths as prickly pear, Spanish-bayonet, and some prickly mimosas, are naturally well adapted to check an attack under fire, while any dense scrub that is not inflammable can be usefully encouraged in hollows and places upon which fire cannot easily be brought to bear.

Communications.

A carefully planned system of communications is an invaluable adjunct of defence. A ceinture road or railway may not always be practicable; but good lateral communications in each section of a fortified position are indispensable, and can generally be protected by the lie of the ground, or by parapets thrown up as part of the preparations for attack. Radial communications with magazines and camps in sheltered positions are also necessary, and should be traced with an eye to protection. The mobility of the Artillery armament, and the consequent power of adapting it to the proceedings of the besieger and of creating for him unpleasant surprises, will thus be greatly facilitated.

Telegraph or telephone lines connecting observing stations with works and batteries, and enabling a general tactical control to be maintained, are almost equally important. Alternative observing stations should be provided, so that

the direction of fire can be transferred from one to the other without delay.

ELECTRIC LIGHTS.

At Port Arthur the Russians employed a considerable number of search-lights, which do not appear to have played any important part in the defence except on the night of the 26th November.[1] It does not follow, however, that they may not be rendered useful. The installations were of a temporary character, and the sites were not all well chosen. To gain the maximum advantage from search-lights it is clearly necessary to have the means of moving them freely and frequently. A fixed light can be quickly located, and will then draw Artillery fire upon itself. Further, the ground which it can illuminate is known to the besieger, and a night attack may thus be facilitated. Alternative sites should, therefore, be selected, and cables should be led to them, so that the projectors, which can easily be transported, may be quickly coupled up, thus rendering the besieger liable to surprises.

ORGANIZATION.

The organization implied will demand the most careful study and forethought, the absence of which in the case of permanent Fortification is absolutely inexcusable. It has frequently happened, however, that all the complicated arrangements which an effective defence entails have had to be extemporized after the investment, with a great consequent loss of power. No detail should be left to the eleventh hour, and the scheme should be complete in every particular. A first-class contoured map of the position and of its terrain for at least 10,000 yards is an essential requirement. That of the position should show every

[1] Star rockets seem to have been employed with some success.

work to be constructed or completed, and the necessary stores, materials, labour, and time, should be accurately estimated. The terrain of the fortress should be divided up into squares, and the organization of the Artillery should be so complete that fire can be concentrated on any square at the shortest notice.

ADVANCED POSITIONS.

The experience of Port Arthur has led to a renewal of the controversy respecting the advantages of holding advanced positions in front of the main line of defence. The German view has been that such positions should not be held unless either the number of available troops is considerably in excess of the regular garrison of the fortress, or the ground in advance of the main line is specially advantageous. French and Russian authorities, on the other hand, have agreed in advocating a free use of advanced positions. At Port Arthur, as has been pointed out (p. 108), the main line was too near to the town and harbour, while the advanced positions to the north and north-west of this line guarded the waterworks and a point (203 Metre Hill) which commanded a complete view of the harbour respectively. Moreover, the Russians had a relatively large force available for the defence. In this case, therefore, the measures taken seem to be justified, notwithstanding the fact that the Japanese obtained a lodgment in the main line nearly three and a half months before the second of the advanced positions was captured. It followed from the nature of the defences that the Japanese gained nothing by their partial success on the 22nd August, which subsequently caused them much loss. If, however, this success had proved of real importance, the policy of maintaining a considerable force outside the main line would certainly have been condemned. On the whole the German view appears sound, and if a fortress

is really prepared for effective defence, no advantage will generally be obtained by holding advanced positions which must fall, and may entail loss of men and of *moral* upon the defenders.

The case of fortresses or places of arms which can be surrounded by a ring of defences has been dealt with above. The general principles advocated will, however, be applicable to *Forts d'arrêt*. It may occasionally be necessary to occupy an isolated hilltop—to create an *Ehrenbreitstein* or a *Fort Bard*. Even so, unless the site is exceptionally restricted, a decentralization of the defence, the divorce of the Artillery positions from the Infantry keeps, and a full utilization of high-angle fire, should be aimed at as far as circumstances permit. In place of a single elaborate and expensive fort, two or three small Infantry redoubts guarding the Artillery positions will usually suffice. If the site is very restricted, and can be surrounded so that the garrison is chained to its works, extensive casemate accommodation will be required, and armour protection for guns using direct fire may be justified. The shallow trace must be modified, and a continuous ring of good obstacles will be needed. The principles above laid down remain unchanged, however, while the *Fort d'arrêt* in a mountainous country will generally have the advantage that its neighbourhood can offer few good Artillery positions for the attack, that formal siege operations are impracticable, and that heavy howitzers or mortars need not be provided against.

If land Fortification is not an absolute anomaly in Great Britain, since the command of the sea implies, now as always, security from invasion, and must be retained on peril of national effacement, at least the problem of defence is greatly simplified. The standard above contemplated is unnecessarily high, since great siege trains, which railways alone can transport and supply, have not to be taken into account.

Much, therefore, may be safely left until an emergency arises, and an organization carefully elaborated in peace-time should suffice to render any extensive creation of permanent works superfluous.

The adoption of the principles laid down in this chapter would lead to a revolution in the teaching of Permanent Fortification, and since they were originally advocated, opinion has been turning in their favour. If, however, much that has been invested with exaggerated importance in the past may now be abandoned with advantage, the qualifications needed for the creation of a well-planned fortress are certainly not less than formerly. On the contrary, the requirements, if all the conditions for an effective defence are to be fulfilled, are now greater than ever. The number of matters requiring consideration is large. To harmonize them, giving to each its due importance, will provide ample scope for genius. The demands of Fortification can never be fulfilled by compass and ruler in the drawing office. The eye, the knowledge, and the organizing capacity of the trained soldier and the student of war, must dominate the designs of the fortresses of the future.

CHAPTER XIII

GENERAL PRINCIPLES OF COAST DEFENCE—POLICY

COAST defence involves two distinct sets of considerations, which should be kept entirely separate.

In the first place, it is necessary to lay down the standard of reasonably probable attack as a basis for determining the strength of armaments and garrisons. In the second place, it is the function of the technical expert to decide upon the positions in which guns can be mounted to the best advantage, the methods of mounting which will give the greatest scope to fire, the organization which will ensure the maximum effect, and the most suitable provision for the defence of the Artillery positions and for the shelter of the personnel.

The primary considerations are, therefore, matters of policy dependent upon national conditions, and varying with circumstances naval, military, and geographical. Unless the coast defences of a maritime country are designed to fit into a harmonious scheme of national preparation for war, they may become sources of weakness by diverting expenditure from essential requirements. Unfortunately, this point of view is usually disregarded, and large sums have been wasted upon fixed defences which could have no value in war, but have been successful in warping national aims and in misleading public opinion. Statesmanship is rare, and technical experts abound, while the palpable and

visible means of protection that coast batteries appear to provide necessarily appeal to uninstructed minds with much greater force than the sea-going navy and the field army, upon which alone national security must ultimately depend. Thus, we have seen waves of coast defence which have strewn our shores with derelict fortifications technically bad even in their day, and now worthless, while the requirements of the field army have been uniformly ignored. Similarly, in the United States, the preposterous proposals of the "Board on Fortifications," which demanded more than five and a half millions sterling for the defence of a comparatively unassailable port such as San Francisco, have created extravagant standards attainable only by a people disposing of superabundant funds, and, if attained, adding nothing to national security.

In this country there are now signs of a rational treatment of the policy of coast defence. It is recognised that the only intelligent basis of schemes of Fortification must be sought in careful estimates of the probable scale of attack, and the Admiralty has accepted the responsibility of preparing such estimates. We may, therefore, hope to arrive at and to maintain a consistent standard which will suffice for all reasonable requirements, and will prevent future waste.

Our naval strength is determined by considerations into which coast defences do not enter, since no one would venture in the present state of opinion to substitute forts on shore for sea-going ships. That strength must be adjusted with the object of conferring upon us the power of controlling an enemy's fleets at sea, and thus of protecting the maritime communications of the Empire. Strategically speaking, our primary requirement in war is that we shall be able to act on the offensive at sea, and upon the fulfilment of this condition our national safety must depend.

The exercise of this power will not—at least, in the early stages of hostilities—enable us to keep the seas clear of an enemy's ships. It must, however, from the very outset, as the experience of the Russo-Japanese War clearly shows, impose special limitations and disabilities upon an antagonist compelled to accept a defensive rôle. In this case, what amount of force could an enemy afford to devote to the attack of coast defences, and what would be the measure of the inducement?

Here a wide and fertile field of controversy presents itself, and the only safe guides must be sought in history and in reason. The unbroken teaching of the past shows clearly that over-sea expeditions, sustained operations on an enemy's coast-line, and blockades, are impossible to a Power which is unable to assert and to maintain naval superiority. Even in the days of the Anglo-Saxon Kings, when the organization and equipment of fleets were in the rudimentary stage, periods of naval strength were invariably associated with the security of the coast-line; conversely, the neglect of naval preparations inexorably entailed invasions, incursions, and raids.[1] The operation of this law can be traced right through our history, and as, with some temporary lapses, British naval superiority has been maintained, it has followed that invasions and raids upon an enemy's territory have been our consistent policy, that our own coast-line has enjoyed immunity broken only when the strength of the fleet had been allowed to decline, and that our territorial dominion has spread over the world by direct over-sea conquest, or by absorption under the ægis of sea-power.

The distinction between an invasion and a raid should be clearly understood. Over-sea invasion is a continuous

[1] See an article by the writer, entitled "Can England be Invaded?" published in the *National Review*, May, 1896, and reprinted in "The Navy and the Nation," 1897 (Murray).

process which now, more than ever, requires the maintenance of unbroken communications during the period necessary to ensure complete military success. The South African War and the Japanese operations in Manchuria are recent cases in point. Both would have been impossible without the command of the sea. The success of the latter depended entirely upon the fact that the Russian squadron accepted, or was forced to assume, a purely defensive rôle.

A raid, on the other hand, is an attempt to seize by surprise some point on or close to a coast-line, with a view to inflict an injury—moral or material—which might cripple, or at least diminish, the fighting resources of an enemy.

The raid, therefore, depends for success upon (1) evasion of the enemy's warships ; (2) immunity from naval interference during the time required for disembarkation ; and (3) the absence of military defence on shore. The sacrifice of a raiding force might be justified if an adequate object could be attained.

Raids involving little or no sea-risk have been frequent in history. Many of Drake's exploits, Rooke's descent upon Vigo in 1702, the conjoint expeditions of Hawke and Mordaunt against Rochefort in 1757, and of Howe and Bligh against Cherbourg in 1758, fall into this category. The last-named operation, in spite of the bad behaviour of the troops, was successful in destroying forts and docks, because condition (3) was fulfilled.

Raids in face of a superior navy have been necessarily rare; but it would be unwise to regard them as impossible. In proportion to the limitation of size of the force employed, the chances of surprise and of evasion at sea are evidently increased. On the other hand, telegraph communication — wireless, especially — has vastly in-

creased the risks of naval intervention before a raiding force has completed its disembarkation.

Thurot's capture of Carrickfergus Castle in February, 1760, is perhaps an instance of a raid carried out in defiance of an adverse command of the sea;[1] but the apparent motive was to obtain provisions. The day after leaving Belfast Lough, Thurot's three frigates were captured, and their gallant Commodore was killed. The incident had not the smallest military or other importance.

The French attempts on Ireland during the War of the Revolution were not raids in any sense, but were political in their objects—abortive efforts to raise a disaffected population in rebellion. Schemes of this kind are rarely successful, since the precise capabilities and sentiments of the people whom it is proposed to convert into effective insurgents are usually unknown quantities.[2]

Writers who ignore, or unconsciously misrepresent, the teaching of war in their eagerness to discredit naval defence have attempted to interpolate a form of attack intermediate between the invasion and the raid. The theory seems to be that a force of about 40,000 men, evading a largely superior fleet in comparatively restricted waters, could be landed in a few hours, being then left to its own resources and to such supplies as it could capture. Such a force, once landed, though cut off from all support,

[1] Thurot, with four frigates and two corvettes, carrying 1,300 troops, succeeded in evading the blockade of Dunkirk on the 15th October, 1759, and, after visiting Bergen, the Faroe Islands, and Islay, he anchored in Belfast Lough with three ships on the 19th February, 1760, and landed about 600 men. Boscawen's victory off Lagos occurred in August, 1759, and in November, Hawke had shattered the fleet of Conflans in Quiberon Bay, as Thurot was aware.

[2] The projected invasions of Louis XIV. and of Napoleon were based upon the supposition that useful allies would be found in England.

would, it is assumed, suffice to paralyze the naval and military activity of Great Britain, and to ensure financial disaster.

Reason and experience combine to demolish this theory. The force postulated, with only 4,000 horses, would, on the Japanese scale[1] of transport for short voyages, require at least 136,000 tons of shipping, or 27 vessels averaging 5,000 tons. Having regard to the information which was available even in the 18th century, it is inconceivable that preparations of this magnitude could be made without our knowledge, and the naval risk to be encountered would, therefore, be appalling. The military mind is well aware that to commit a huge defenceless baggage train to a long march through a country known to be infested by thoroughly efficient light cavalry would be an imbecile proceeding; but the absolute helplessness of a crowded transport at sea is frequently forgotten by persons ready to attribute to others an aptitude for criminal folly which they would warmly repudiate for themselves. The rumour that a Spanish armoured cruiser had been sighted off the north coast of Cuba sufficed to delay the sailing of the American expeditionary force from Tampa in June, 1898. The rumour was improbable to the last degree, but there is not the smallest doubt that a single cruiser would have entailed disaster upon this expedition of 13,000 men. Although the conduct of war abounds in mistakes, we dare not hope for such good fortune as that an enemy would follow the advice of our theorists.

A further assumption must be noticed. If, as proved impossible in sailing days, when telegraphy was unknown, a large expedition succeeded in evading an immense naval force available to intercept it, and effected a land-

[1] The actual Japanese figures were 68,760 tons for 14,330 men and 3,008 horses.

ing[1] without interruption, the idea that this country would be paralyzed and rendered impotent implies a depth of national degradation which the theorist would probably be reluctant to admit. At least, it is certain that, in parallel conditions, a numerically inferior force of Boers would effectively neutralize, and eventually reduce to starvation, the 40,000 incursionists. Unless, therefore, the military potentiality of 38 millions of British people, aided by a dense network of railway communications, is distinctly less than that of the Boers, we have no cause for alarm.

One other prevalent theory may also be dismissed. The Powers of Europe are not organized assassins, and they will not, if they could, strike a blow at a time when international relations are unclouded. That war usually breaks out without a formal declaration is an obvious platitude; but studied acts of war will not be perpetrated at a moment when no diplomatic difficulty exists. Time will, therefore, be available for naval precautions, always easily and quickly taken, and incapable of being neglected by any Government or Admiralty.

The most inveterate panic-monger would probably admit that invasions, incursions, or raids cannot be undertaken by a belligerent whose fleet is unable to keep the sea, and that the coast defences of the other belligerent must necessarily be deprived of all useful functions.

This was the case of both British and French coast defences in 1854-55, and of the latter in 1870-71. On the other hand, if an island State, rich, wholly self-supporting, and possessing no navy or maritime commerce, can be imagined,

[1] This, in the most favourable conditions of weather and organization, would require about thirty hours, having regard to the large amount of ammunition and other impedimenta which the hypothesis demands.

coast defences might in such a case become a national object of primary importance, and the fortification of every harbour capable of being utilized as a base for an invading army might be justified. The conditions in war will generally lie between these two extremes, and in all cases the necessary standard of coast defence will depend upon the relative powers of the fleets of the belligerents.

Japan, confronted in adjacent waters by a Russian fleet approximately equal—on paper—to her own, could not afford to neglect the defences of her great ports. From the moment, however, when it became clear that this fleet was well under Japanese control, these defences became negligible factors in the conduct of the war. Had Rodjestvensky's desperate venture succeeded, as there was no reason to expect, and had the Japanese fleet sustained a defeat so crushing as to reverse the naval situation, and to confer unquestioned naval superiority upon the Russians, their first object would have been to sever the communications of the large Japanese forces over-sea. At a later period, when these forces had been defeated or destroyed, and when a Russian invasion of Japan had become a possible operation, the coast defences of the latter might have been called upon to exercise their functions.

It should, however, be clearly understood that coast defences, by which are usually meant the means of safeguarding the approaches of a port, generally afford no direct protection against invasion. To guard a long coastline by guns, or by men in fortifications, is as a rule impossible. The most that can be done is to deter an enemy's ships and torpedo craft from entering a certain number of important harbours, and to prevent the destruction by an enemy's naval guns of shipping, docks, and national resources centred in these harbours. Landings in grèater or less strength at points undefended by fixed de-

fences have been frequent in the past, and are equally practicable now on the conditions above stated (p. 171).

These conditions were fulfilled in the case of the operations begun by the Allies at "Old Fort" on the 14th September, 1854, and by the Americans at Daiquiri on the 22nd June, 1898, which, therefore, though requiring about four days in each instance, were completely successful. As soon as an invading force has been established on shore, it must, unless its objects can be instantly accomplished, seek to establish communications independent of weather. Hence will arise the necessity for occupying a convenient harbour, the purely coast defences of which will then be effectually turned. Thus, the landing at Old Fort and the Russian defeat on the Alma were followed by the flank march which gave the Allies the possession of Kamiesch Bay and Balaclava as the necessary preliminaries to a sustained attack on Sebastopol. The Americans had previously secured Guantanamo Bay, which might have served, as was intended in 1741, as a base for an attack on Santiago if the operations had not quickly ended. In neither instance—Sebastopol or Santiago—could the fleets of the attacking Powers render any important direct assistance,[1] and both places fell as a consequence of the land attacks, thus exactly conforming to the case of Syracuse in 212 B.C., and to a long series of analogous experiences ending at Port Arthur.

The lessons of war prove that coast defences, so called, almost invariably fall as the result of a land attack, and that even when they are technically contemptible—

[1] The naval attack on Sebastopol on the 17th October, 1854, cannot be said to have furthered the objects of the Allies in any way, while it entailed a loss of 520 men. Similarly, the several bombardments of the Morro and Socapa batteries, and the blind firing of the 10th and 11th July, 1898, into Santiago, did not contribute in any degree to the surrender. On the other hand, the tardily undertaken conjoint expedition to Kertch was a stroke of real importance.

as at Santiago—they serve their purpose. The Spaniards would have gained no advantage if the Morro and Socapa batteries had been as well armed as the defences of Kiel, and the most effective coast work at Sebastopol was the Telegraph battery, which, from the point of view of Fortification, was an elementary structure.

There are *a priori* reasons for the existence of this general law. Warships are not built to attack defences on shore, and can rarely be spared for the purpose, while the progress of military science has turned the balance heavily against them. They have succeeded in silencing coast batteries in such cases as Algiers (1816), Acre (1840), Alexandria (1882), where they could be employed without restraint, and where the enemy's artillerymen were untrained and incompetent. They have invariably failed where the coast defences were well placed, sound in conception, and capably fought.

At Cape Licosa, in 1806, a single gun successfully opposed an 80-gun British ship and two frigates, which expended most of their ammunition without effect (see footnote, p. 230). In 1793, a redoubt in Corsica mounting two 18-pounders and one 9-pounder repulsed three line-of-battle ships—*Alcide, Courageux*, and *Ardent*—with loss. In the same year the original Martello tower was attacked and taken by the *Lowestoffe* and *Nemesis* frigates, but in 1794 this tower drove off the *Fortitude* and *Juno* (the former with a loss of sixty-two men and on fire), and succumbed to an attack by guns established on shore.[1] The Wasp and Telegraph batteries at Sebastopol put six British ships out of action. At Alexandria, the fleet would unquestionably have been compelled to withdraw after being roughly handled and expending most of its ammunition, if the Egyptians had known how to use their heavy rifled guns.

[1] On this slender basis rested the great expenditure incurred upon Martello towers in Great Britain.

The defences of San Juan Puerto-Rico were bombarded by Admiral Sampson's squadron for two and three-quarter hours on the 12th May, 1898. The warships carried four 13-inch, four 12-inch, eight 10-inch, twenty-two 8-inch, twenty 5-inch, fourteen 4-inch, and smaller quick-firing guns, from which about 2,000 rounds were fired. The defences engaged mounted eleven 15-centimetre guns and five 21-centimetre howitzers, which fired about 440 rounds. The Spanish practice was very bad; but the works[1] and their armaments were practically uninjured.

At Santiago, the only modern armament consisted of two 16-centimetre guns in Socapa battery. Another battery near the Morro Castle mounted five 16-centimetre guns, old smooth-bores rifled. In addition, there were five 21-centimetre muzzle-loading howitzers of little or no value. The works, mainly extemporized after the outbreak of war,[2] were shelled by the powerful American fleet on ten occasions,[3] with the result that one gun was temporarily put out of action, and one was permanently disabled. The losses in and near the Spanish batteries amounted in all to 10 killed and 118 wounded, due to the absence of the cover which properly designed permanent works would have provided. The *Texas* was hit by a 16-centimetre shell from the Socapa battery, and the *Indiana* by a 21-centimetre shell from the Morro. Great credit is due to the Spaniards for the persistent resistance opposed to an overwhelming force. The works had the sole advantage of being at a height of about 206 feet above the sea; but no attempt had been made to secure their invisibility. Nevertheless, these improvised

[1] The total estimate of repairs to the forts made after their surrender was about £450.

[2] The Morro battery was constructed of boxes and barrels filled with cement.

[3] The range on some occasions was as short as 2,000 yards.

defences armed with siege guns mostly obsolete served their purpose.

The Japanese, in 1894, gave proof of their mastery of the lessons of war by consistently declining to expose their warships to the fire of coast defences. The attacks on Ta-lien-wan, Port Arthur, and Wei-hai-wei were, therefore, military operations, the Japanese fleet being restricted to its proper functions. At Wei-hai-wei, the Chinese coast defence guns were effectively used by the Japanese against the Chinese ships.

The Russian coast defences at Port Arthur in 1904 mounted seventy-three guns and howitzers, 6-inch and upwards, all in open emplacements at heights from 120 to 320 feet.[1] The Japanese bombarded the forts on 25th February, 10th and 22nd March, 15th April, and 23rd August. On the first occasion the number of rounds fired was small, and the ships drew off when the Russians began to obtain their range. On the 10th March a subdivision of battleships fired 145 12-inch shells at 13,000 to 14,200 yards, on 15th April two battleships fired about 150 12-inch shells at about 20,000 yards, and on 23rd August the forts on the right flank of the defences of Port Arthur were bombarded for a short time. In all these cases, the Japanese were most careful to avoid risk to their ships. The effect of their fire upon the coast defences was nil,[2] but occasional shells may have fallen in the town. The object of the bombardments is not apparent, and the wear of the 12-inch guns might have been spared; but some moral effect may have been gained.

[1] In the eastern forts: Six 11-inch howitzers, five 10-inch guns, eight 9-inch guns, ten 9-inch howitzers, eleven 6-inch Q.F. guns; total, forty. In the south-western forts: Four 11-inch howitzers, four 9-inch guns, twelve 9-inch howitzers, thirteen 6-inch Q.F. guns; total, thirty-three. The works were spread over about five miles of coast-line.

[2] Some slight damage was sustained by fire from the land side.

When, in July, 1889, the American Secretary of War was urging that the fleet should force the entrance of Santiago Harbour, the Secretary of the Navy telegraphed to Admiral Sampson : " I leave the matter to your discretion, except that the United States armoured vessels must not be risked."

This restraining influence must always exist, except in a case in which the navy of one belligerent is not required for combatant action at sea. In such a case, and if it could be safely assumed that no naval complications with neutrals would arise, it is conceivable that, regardless of possible damage or loss, warships might be freely employed as floating batteries in the attack on an enemy's fortified harbours. Even in such highly special conditions, it would be necessary to consider carefully whether the results would justify the means. The offensive power of the ship for an attack of this nature depends upon heavy and medium guns, wholly or partially protected, and capable of being used only from positions into which she can be floated. It is not difficult to imagine places which could be held effectively by a vigorous defender, with rifles and mobile guns only, after an enemy's ships had beaten down the fire of the fixed defences and obtained entrance to interior waters.

All such considerations, however, have no bearing on the standard of coast defence necessary in the British Empire. It is conceivable that we may be engaged in a war in which the Navy would not be called upon for combatant action on the seas. Even then the policy of risking ships in enterprises for which they are not fitted would not be lightly adopted, and the attitude of the Secretary of the American Navy in 1898[1] might commend itself to the Admiralty. It is inconceivable, unless our fleet is allowed to sink into decadence, that a hostile Power or Powers would be in a position to divert ships from their proper sphere of

[1] See above.

action at sea to the attack of moderately armed British coast defences. There are, in fact, only two logical courses of action for a fleet or a combination of fleets opposed to our own :

1. To strain every effort and to sacrifice every other aim in order, by winning great fleet actions, to destroy the sea supremacy of the British Navy. If this object could be attained, our coast defences would at once cease to possess real national importance. If it were not attained, our imaginary enemies would be no more able to attack our coast defences than were the Russians to attack those of Japan in 1904.

2. To avoid fleet actions, and to concentrate all effort upon a *guerre de course* waged against British commerce. In this case, the main object must be to keep the raiding ships at sea, avoiding observation, and consequently giving a wide berth to the British coast-line. Moreover, the vessels best suited for work of this nature are those which would be unable to face even such miserable defences as existed at Santiago.

History clearly proves that the second course (2) cannot succeed in the long-run, and that effective warfare against commerce can be carried on only by the belligerent whose battle fleets are either victorious or able to control effectually the battle fleets of the ènemy. The attractions presented by the vast volume of British maritime trade are, however, so strong that organized attacks upon it must be expected. Whether any initial successes could be obtained would depend mainly upon the measures of peace preparation taken by the Admiralty, and upon the forethought devoted to arrangements for transmitting information, and for adapting the movements of the mercantile marine to the conditions of war.

Reason combines with the rich and varied experience of

the past, culminating in the recent conflict in the Far East, to prove that the functions of coast defence in war between naval Powers are necessarily restricted and subordinate to the main issues. Fortified harbours from the days of the Romans to our own have usually fallen to a land attack rendered possible by naval superiority. Coast defences pure and simple, when garrisoned by trained men, have rarely failed to discharge their limited rôle, and their most conspicuous successes have been attained by simple means. Isolated fortified ports will necessarily fall victims to sea-power exerted over a sufficient time, as Gibraltar must have surrendered to the French and Spaniards if not relieved by the British Navy, as the possession of Minorca oscillated from one side to the other in strict accordance with the naval situation.

In recent years, the British people have awakened to a sense of their supreme naval needs, and the principles which all history, and especially that of the period of great naval wars, enforces have tended to reassert themselves as governing factors in our national policy. It is understood that the Navy must be maintained at a strength sufficient to enable it to control the movements of the fleets of any reasonably probable combination of Powers, and that if this condition is not fulfilled in war, no measures of military preparation, and no employment of fortification, can avert disaster from an Empire wholly dependent for existence on maritime communications. "The maintenance of sea supremacy," stated the Duke of Devonshire,[1] "has been assumed as the basis of the system of Imperial defence against attack from over the sea. This is the determining factor in shaping the whole defensive policy of the Empire." There can be no other logical "basis" on which to build a standard of coast defence.

[1] At the Guildhall, 3rd December, 1896.

It is assumed, therefore, that an enemy's battleships will either be brought to action, or will be kept under observation and prevented from undertaking any serious operations without incurring the certainty of being brought to action within a limited time. We cannot, however, count upon being able—especially in the early stages of war—to prevent hostile movements against our commerce on the seas. Nor can we guarantee that our ports will be absolutely immune from such a futile attack as that delivered by Admiral Sampson's squadron on San Juan (p. 178), if it should seem to an enemy's commanders that any adequate advantage could thereby be attained. In our case, however, the attractions of a rich and dense volume of commerce must necessarily be superior to the prospect of engaging guns on shore on most unequal terms. It may, therefore, be expected that an enemy's ships, escaping for a time from the observation of our Navy, would naturally turn their attention to trade on the high seas, and avoid being sighted from any point on the coast-line, whence their presence would be instantly reported in all directions.

From the above considerations it appears that the standard of reasonably probable naval attack upon the home and colonial ports of the Empire can be estimated with sufficient accuracy by the Admiralty, and must, at the present time, be such as could be repelled without difficulty by moderate armaments effectively handled by trained gunners. Revision of standards to meet the changes in the balance of naval power which may arise in the future might evidently be required.

The ports which require coast defence fall under the following heads :

1. Naval bases essential to the maintenance of the fleet.

2. Strategic harbours, such as Portland and Dover.

3. Great centres of private shipbuilding industry, naval or mercantile.

4. Commercial harbours which must be kept open in war.

5. Harbours in which mercantile ships might congregate for temporary refuge in time of war.

The principle is that only ports containing resources of national importance—resources the destruction of which would directly reduce the capacity of the nation for carrying on war—can be fortified. All other ports must depend upon naval protection alone, and irresponsible threats of bombardment and of the enforcement of indemnities, to which naval manœuvres have accustomed us, can be disregarded. Bombardments would only lead to reprisals, which the superior naval Power can easily carry into effect; while indemnities can only be collected by a process of pillage involving the landing of men. This should be impossible if the Volunteers were properly organized.

It follows that Colonial ports, such as those of South Africa, Australia, and New Zealand, at long distances from the bases of a possible enemy, should not be left defenceless if they contain docks, shipping, and large stores of coal. On the other hand, a few effective guns will amply suffice for their protection, provided that there are local military forces able to repel such a landing-party as two or three cruisers possibly accompanied by a transport could supply. These conditions can easily be fulfilled in the case of all the ports which it is necessary to defend. A somewhat higher standard is justified at naval centres such as Singapore and Hong-Kong, the capture of which might hamper the free action of the Navy. Little, however, could be expected from purely naval attack, and the possibility of employing forces on shore would depend upon successful evasion of British warships, which would naturally pay special atten-

tion to any ports at which such expeditionary forces might embark.

Authoritative decisions on the various questions above discussed are required before the legitimate functions of the Artillery and Engineer expert can be brought into play. When the general policy has been laid down, it becomes possible to formulate details applicable to individual cases.

CHAPTER XIV

MOUNTING OF COAST ARTILLERY—EVOLUTION OF COAST BATTERIES—OLD FORMS OF GUN-MOUNTINGS—RECENT DESIGNS

The general policy of coast defence having been determined, and the standard of attack to be opposed having been laid down, it is necessary to consider how to mount the required armament to the best advantage.

Thus, the science of coast Fortification may perhaps be defined as that of distributing and mounting guns of various natures with a view to ensure that—

(1) The offensive power of the gun shall have its fullest scope from the position of greatest advantage, and that

(2) The protection afforded to the gun itself and to the gunners who man it shall be the maximum compatible with (1) and with reasonable economy.

Passing over the period when guns were mounted in castles, and active defence had not begun to assert itself, the earliest form of coast battery was probably a low *barbette*, the guns simply firing over a wall or bank. Examples of such batteries are still scattered round our coasts, and are occasionally used for saluting purposes. The invention and development of shell fire soon tended to produce a higher front protection, and the embrasure both in earth and masonry arose, the latter usually involving a stone or brick fort, with casemates such as those which were largely

constructed in the United States. The fort, trying to compete with the ship in volume of fire, would sometimes have two, three, or four tiers. Thus, the Spithead forts were originally designed for four tiers, and were also intended to mount guns on the top, while there is an existing three-tier stone-work at Kronstadt.[1] Great crowding of armament thus arose.

The development of penetrative power which the rifled gun attained led naturally to the adoption of iron shields, and works of the Bovisand, Popton, Hubberstone, Hoo, and Darnet type were constructed, the double tier being retained in some cases, as at Picklecombe and Garrison Point. The desire to imitate the ship further, gaining still greater protection, and of a more uniform nature, produced the continuous armoured fronts at Spithead, Plymouth, and Portland. Finally, still following the ship, a cramped advanced site, exceptionally heavy guns, and the desire to realize complete protection combined with an all-round fire, produced the Dover turret.

Meanwhile, however, the expense and other disadvantages of the stone and iron method naturally directed attention to alternative modes of protection. As early as 1835, Colonel de Bussy, of the U.S. Army, invented a carriage in which the gun was rolled to the rear on eccentric wheels and lowered. In 1868, Major King, U.S. Engineers, invented a counterpoise carriage which was successfully tried with a 15-inch gun firing a 450-pound projectile with 100-pound charge. About 1871, Colonel (the late Sir A.) Moncrieff also reduced the disappearing principle to a practical shape, and succeeded, in 1873, in overcoming great difficulties with marked energy and mechanical skill. In spite

[1] The Russians appear to have been the greatest exponents of this system, and such works as Fort Constantine at Sebastopol probably exercised a baneful influence over our own later coast defences.

of a highly favourable report on the counterweight carriage for the 9-inch gun of 12 tons, this mounting can hardly be said to have been introduced into our service—there were only two examples[1]—and practically the principle was restricted to guns not heavier than the 7-inch of 7 tons. The principle was applied to the best advantage at Flatholme (Severn defences), where the emplacements were dispersed and well concealed. These emplacements, being well conceived, were as satisfactory when their armament became obsolete as when they were first built. The worst instances were at Popton and Hubberstone (Milford Haven), where the pits were built up in a row on the top of stone and iron casemates, and at Newhaven, where one of the 9-inch guns was mounted in a species of demi-Martello tower. In these cases, the value of the Moncrieff system was gratuitously reduced to a minimum.

The rapidly increasing cost of this mounting in the case of larger guns led Colonel Moncrieff to the design of hydro-pneumatic carriages, which are represented in principle by the disappearing mountings constructed at Elswick, and successfully applied to 6-inch, 8-inch (Plates XXIV. and XXV.), 9·2-inch, 10-inch, and 13·5-inch B.L. guns.

Up to a certain point, therefore, the maximum possible of material protection appears to have been the object aimed at in gun-mounting. At the same time the great cost of invulnerability of this class rendered other modes of protection necessary in some cases, and open batteries have not only never disappeared, but have been largely constructed.

The French, who have not been committed to wild expenditure on coast defences, steadily abstained from constructing armoured casemated batteries, and the great majority of their guns were mounted *en barbette*. In the case of fairly elevated sites this principle, on account of its

[1] At Newhaven.

relative cheapness and wide angle of fire, has always found favour, and it has been largely applied to battleships,[1] in which, however, the turret of four-sided or polygonal form has latterly been introduced.

The rapid development of machine and quick-firing guns tended to increase the minimum of height above the sea-level prescribed for *barbettes*, to add to the height of front parapet, and to bring methods of under-cover loading into prominence. The heaviest British guns mounted—the 100-ton R.M.L. at Gibraltar and Malta—are *en barbette*, fire over a high parapet, and have a complete system of under-cover loading, so that the gun alone is exposed to direct fire.

All methods of gun-mounting, existing or proposed, may be classed under three heads :

1. Complete material protection, limited only by the size of a port, to detachment, and to gun during loading.

2. Varying protection against direct fire. No bomb-proof overhead cover. Detachment more or less protected in various ways.

3. Gun completely protected during loading by being lowered.

The following is a brief statement of the advantages and disadvantages of the methods severally included in the above groups, with examples of their practical application[2] up to 1890 :

Group I.

(*a*) *Shielded Casemates.*—Two tiers, Picklecombe, Garrison Point. One tier (see figure), Bovisand ; Thames and Medway defences ; Hurst Castle ; Seaforth ; Forts Tigné and Delimara, Malta.

[1] *E.g.*, in the *Téméraire* and in the *Admiral* class.

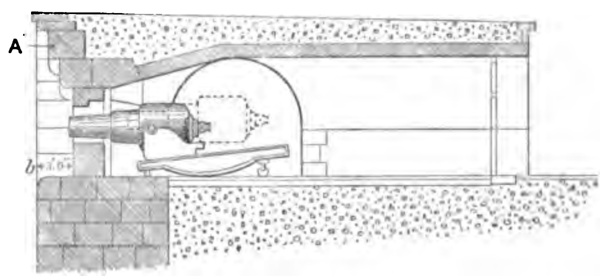
[2] In many cases these works have now been disarmed as the result of the introduction of the long breech-loading gun.

Advantages.

Complete protection to mounting and detachment against heavy projectiles, limited only by the thickness of shield adopted, the strength of the masonry in which the shield is fixed, and the size of the port. Complete protection against high-angle fire, machine-gun fire, and shrapnel, except at the port.

Disadvantages.

Cost entails crowding of guns, which is inadvisable in several respects. Always offers an ideal target, especially in the case of a two-tier work. Target increased by massive overhead protection, which is not required, and by presenting a vertical face to front attack ensures the maximum effect to projectiles. Liable to cumulative damage at long range. Port usually limits elevation of guns. (At Garrison Point the heaviest guns had the least range.) Lateral range of individual guns limited. Field of view restricted for aiming purposes. Difficulties arise from powder smoke. Now obsolete.



Scale $\frac{1}{16}$ inch = 1 foot.

SECTION OF CASEMATE BATTERY. SINGLE TIER.

(*b*) *Curved Front Shielded Casemates.*—King's Bastion, Gibraltar, Sliema Fort, Malta.

Advantages.

See above. Large field of fire; curved form incidentally unfavourable to penetration, except to nearly direct hits. Shield provides uniform protection to casemate except on the flanks, where it is set in masonry.

Disadvantages.

See above. The alternative port is a source of weakness. A single shell entering there would almost certainly disable the gun. Time is lost in traversing from port to port, and, consequently, there is difficulty in following a moving object. Now obsolete.

(*c*) *Continuous Iron Front.*—Two tiers, Horse Sand and No Man's Land, Spithead. One tier, Spitbank, Plymouth and Portland Breakwater Forts; Fort Cunningham, Bermuda.

Advantages.	*Disadvantages.*
Complete and uniform protection, except at port, against projectiles of all sorts, limited only by thickness of armour adopted. Overhead protection. Closest approximation to a broadside armour-clad.	Costly; crowding of guns therefore inevitable. Usually a conspicuous target. Elevation and training limited. Field of view restricted for aiming purposes. If penetrated, it is possible that two guns could be disabled by a single projectile. Obsolete.

(*d*) *Grüson Battery.*—Langlütjensend, German defences on Baltic and North Sea.

Advantages.	*Disadvantages.*
Protection very complete. Curved form of armour favourable to deflection of projectiles. Economy over wrought iron or compound armour claimed, but possibly not sufficiently established. Requires the occurrence of several hits in a small area to produce much result. Port reduced to a minimum.	Costly; guns necessarily crowded, thus giving to the attack a considerable margin in direction of fire. Individual segments proved to be capable of being broken up by repeated hits. Probably somewhat cramped. Lateral range of individual guns limited. Field of view restricted.

(*e*) *Turret.*—Dover sole English example; Fort Milutine at Kronstadt.

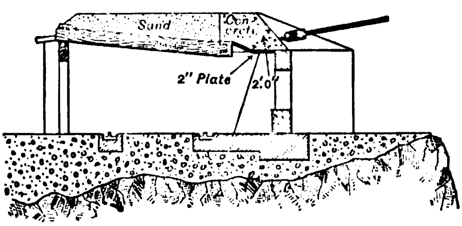
Advantages.	*Disadvantages.*
Complete protection, limited only by thickness of armour and size of port. Curvature unfavourable to penetration. Relatively small target. All-round fire. Two guns combined in one protection. Overhead protection against shrapnel and splinters. Conning tower affords good field of view for aiming purposes. Satisfactory on board ship.	Excessively costly. Steam or hydraulic power required. Not well suited to colonial conditions generally. Somewhat conspicuous.

(*f*) *Grüson Turret.*—German defences in the Baltic and North Sea ; defences of Holland ; Spezzia.

Advantages.	*Disadvantages.*
See Turret. Cast-iron allows any curvature of form. Economy claimed.	*See* Turret. A segment several times hit will break up ; the destruction of a segment would seriously affect whole turret. Somewhat conspicuous.

GROUP 2.

(*a*) *Open Battery with Shields* (see figure).—New Tavern Fort ; some works at Gibraltar.

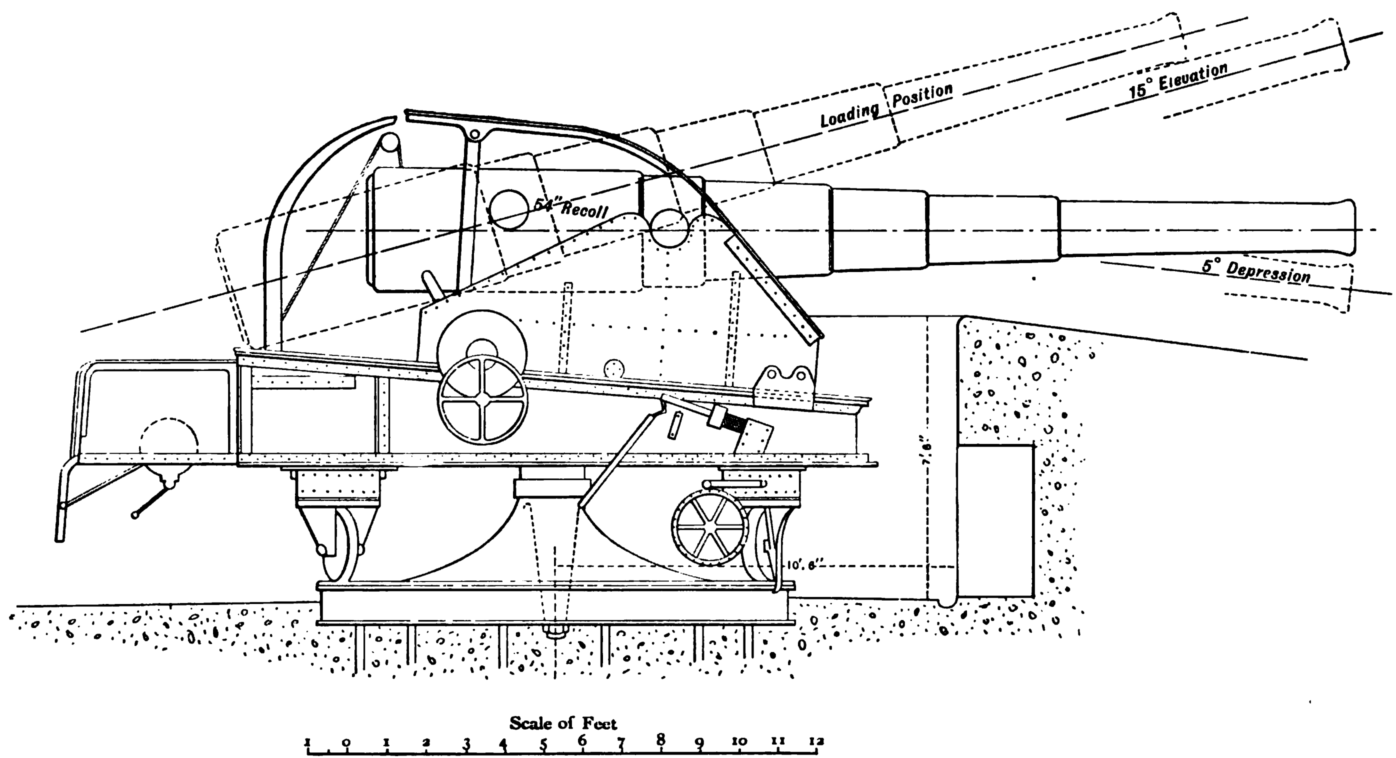


Scale $\frac{1}{10}$ inch = 1 foot.

SECTION OF OPEN SHIELDED BATTERY WITH OVERHEAD COVER.

Advantages.	*Disadvantages.*
Great front protection, as merlon can have unlimited thickness of earth. No exposed masonry required. Can be rendered fairly inconspicuous.	Difficulty in affording adequate support to the shield, which can have only side and bottom abutments, while the top is unsupported. Angle of training limited. Elevation to some extent restricted. No proper overhead cover, since the latter, as usually provided, was useful against shrapnel and splinters only, and by adding to the height of the target increased the danger from heavy common shell. Now obsolete.

PLATE XXIII.



BARBETTE MOUNTING FOR 9·2-INCH B.L. GUN.
(ELSWICK DESIGN ABOUT 1888.)

[To face page 193.

(*b*) *Open Battery with Earth Embrasures.*—South Hook, Milford Haven; defences of Marseilles; all the heavy gun batteries at Alexandria except Meks.

Advantages.	*Disadvantages.*
Cheap. Lends itself to dispersion. Can be rendered very inconspicuous as a target. Fair protection against machine-gun fire, at least till much of embrasure is destroyed. Protection easily capable of repair. Great flank protection can be given.	Embrasure necessarily weak at the neck. If gun is on a low carriage, detachment exposed to shrapnel and machine-gun fire after neck is destroyed. Horizontal angle of fire limited. Obsolete.

(*c*) *Barbettes.*—For old-type guns, with bonnettes, Isle of Grain Fort; without bonnettes, Inchkeith, Harding's Fort, and Europa Hutment, Gibraltar. For breech-loading guns (see Plate XXIII.), Stonecutters' Island, Hong Kong.

Advantages.	*Disadvantages.*
Angle of fire unlimited unless bonnettes are employed. Lends itself well to dispersion. Can be rendered inconspicuous as a target, if properly treated. Well suited to breech-loading guns on moderately high sites, or where ships cannot close. Relatively cheap.	Gun itself necessarily more or less exposed. If not bonnetted, specially exposed on flanks, where it offers a broadside target. In the case of low sites, protection to detachments necessary; but was difficult to arrange in the case of larger natures of R.M.L. guns.

(*d*) *Breech Hoods with Barbette Guns.*—Hoods were provided for upper deck guns as the first step in the protection of the light armament of ships. Bullet-proof shields of various forms have also been provided for barbette guns (see Plate XXIII.).

Advantages.	*Disadvantages.*
See Barbettes. Good front protection against machine-gun fire and shrapnel to loading numbers and breech action. Possibly additional protection against a hit by a heavy projectile at a small angle.	*See* Barbettes. Lateral protection *nil*, unless angle of training is comparatively small. Shell otherwise harmless may be burst by the hood.

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Group 3.

(*a*) *Moncrieff Counterweight Mounting.*—Flatholme, Lavernock, Popton, Hubberstone, Newhaven, Carlisle, Camden.

Advantages.	*Disadvantages.*
Excellent protection to gun and detachment. Laying performed under cover. Can be rendered absolutely invisible except for the short time the gun is up.	Unsuitable to B.L. guns. Carriage necessarily somewhat complicated. Weight increases rapidly with that of gun. Has been applied to no gun heavier than 9-inch of 12 tons. Now obsolete.

(*b*) *Hydropneumatic Mounting.*—Applied to 6-inch, 8-inch (Plates XXIV. and XXV.), 9·2-inch, and 10-inch B.L. guns. Largely adopted in coast works constructed between 1880 and 1890.

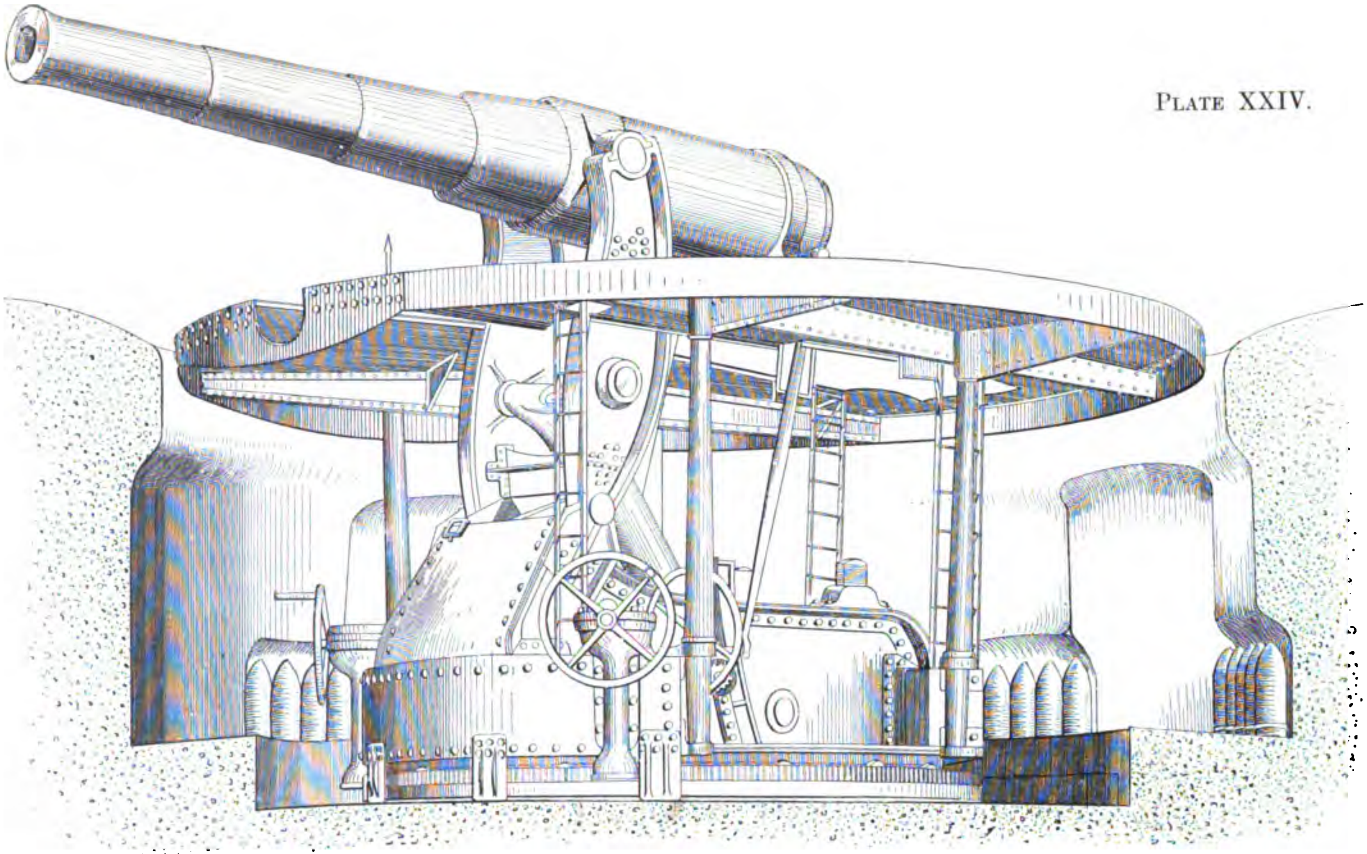
Advantages.	*Disadvantages.*
See Counterweight Carriage. Addition of a horizontal or turtle-back shield confers good overhead protection. Well suited to guns on low sites. Practically unattackable by ship's fire.	Requires special care in maintenance. Difficult to repair. Slow rate of fire.

(*c*) *Counterbalanced Disappearing Mounting.*—Fort Constantine at Kronstadt.

Advantages.	*Disadvantages.*
See (*a*) and (*b*) above. Gun can be sunk as low as desired below crest of parapet. Gun can be worked simply *en barbette* if desired.	Both gun and platform have to be raised and lowered. Steam power required. Costly and somewhat complicated. Apparently applied to 11-inch B.L. long guns. Not much known as to success of working.

The methods of iron protection enumerated in Group 1 and Group 2 (*a*) can scarcely be said to have as yet stood the test of war. The shielded casemates cleverly extem-

PLATE XXIV.



8-INCH B.L. GUN ON HYDRO PNEUMATIC MOUNTING. (ELSWICK.)
GUN IN FIRING POSITION.

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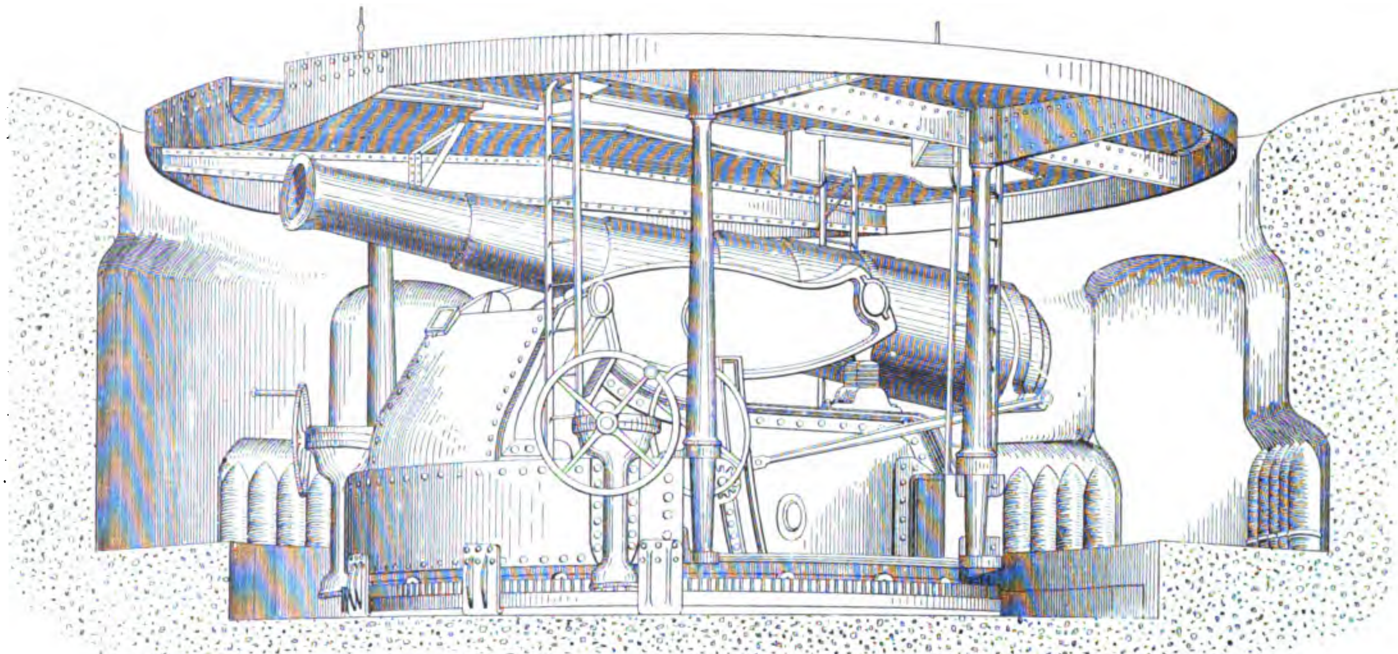
PLATE XXV.



8-INCH B.L. GUN ON HYDRO PNEUMATIC MOUNTING. (ELSWICK.)

GUN IN LOADING POSITION.

[To follow Plate XXIV.

porized during the American War cannot be taken as fair specimens of their class; nor can the experience gained with the American monitors be considered of value in estimating the effective protection conferred by a modern turret or cupola. The 5½-inch iron armour of the *Huascar's* turret was, however, hit three times by 9-inch Palliser shell in her action with the *Blanco Encalada* and *Almirante Cochrane.* The turret was twice penetrated, and a shell burst on the deck below without preventing it from revolving.

Further, there have been few experiments made under approximately service conditions, with the exception of those carried out at Shoeburyness against two shielded casemates in 1865, and against two iron-fronted casemates in 1868.[1] Important trials of experimental shields were also made in 1867, 1868, 1869, and 1870. Three shots were fired at the turret of the *Royal Sovereign* in 1867, and two shots at the *Glatton's* turret from the *Hotspur* in 1872. The guns employed against the shielded casemates were 10-inch of 12 tons, 9·22 inch of the same weight, 8-inch and 7-inch; against the iron-fronted casemates 12-inch of 25 tons, 10-inch of 18 tons, 15-inch S.B. of 19 tons; against the *Royal Sovereign*, 9-inch; and against the *Glatton*, 12-inch of 25 tons; so that as indications of what might be effected by the far more powerful guns now afloat, the results of these experiments are valueless.

The *Belleisle* trials and the naval actions of the China-Japanese and Russo-Japanese Wars have thrown further light on the defensive capabilities of armour, and have proved conclusively[2] that the protection conferred is, for practical purposes, far greater than experiments on the

[1] See a paper by Colonel Inglis, R.E., "Professional Papers," Second Series, vol. xviii.

[2] As was anticipated. "Armour will unquestionably prove a more effective protection in action than Shoeburyness experiments may seem to indicate" (1st edition, 1890).

proving-ground appear to indicate. The theoretical penetration of armour, which can be calculated with considerable accuracy, supplies a convenient standard for estimating relative gun-power; but must be heavily discounted for purposes of war. The contest between armour and guns still continues unabated, and has led to remarkable developments in both. At the same time, penetration, as such, has ceased to be regarded as the principal object to be arrived at. The main effort now is to provide a shell capable of carrying a large bursting charge through or into an armour-plate, and, on the other hand, to provide hard-faced armour able to break up or explode such a shell before penetration. Thus the point of view has somewhat changed, and armour is now applied on board ship in less thickness and for other purposes than formerly. It is becoming doubtful whether the resisting power of armour of a given thickness is capable of material increase, although the limits of gun power have not yet been reached.

Meanwhile, a marked change of opinion has arisen as regards methods of mounting guns for coast defence. It is realized that earth-work batteries acquitted themselves exceedingly well when severely tried at Alexandria under conditions extremely favourable to the naval attack, thus fully confirming the experience of the American Civil War in the early days of rifled guns. The tendency to reproduce in the coast battery the disadvantages inherent in the ship, which during a long period entailed heavy expenditure upon bad designs, has happily passed away. The principles laid down in Chapter XIII. are now generally accepted, and methods of gun-mounting are being made to conform with these principles.

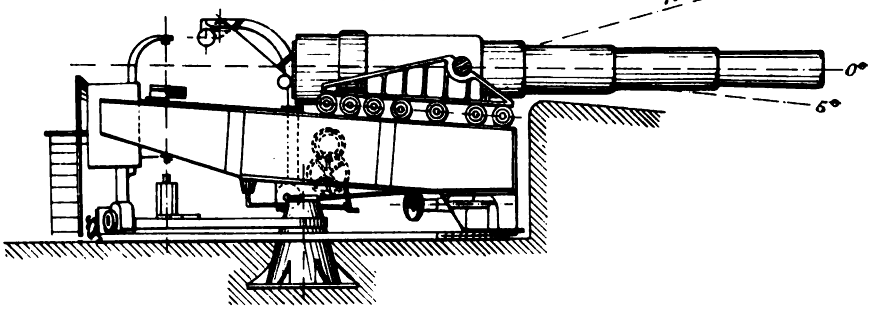
The writer became Superintendent of the Royal Carriage Department in August, 1894, and endeavoured for seven years to effect improvements with a view to remedy the

DIAGRAM
— SHOWING —
EVOLUTION OF 9·2 IN. MOUNTINGS.

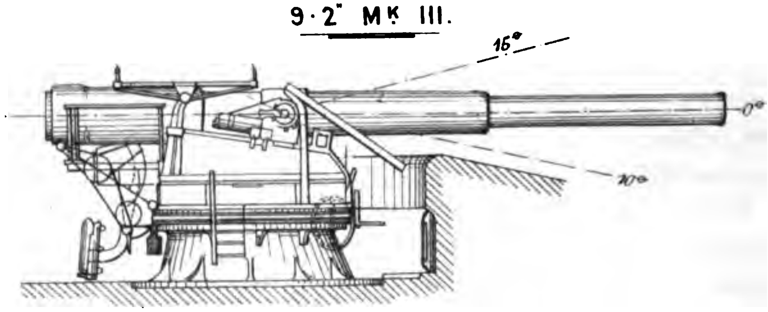
Scale.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 FEET.

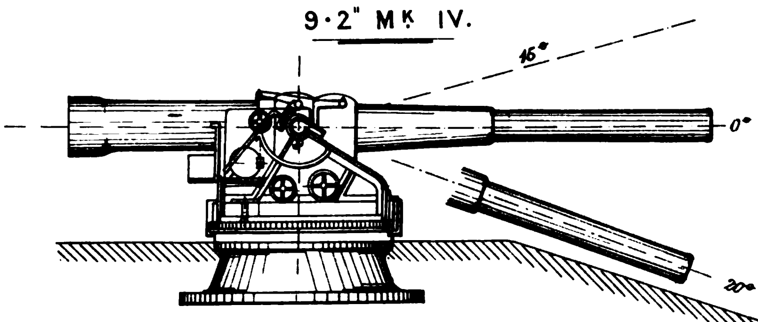
9·2" Mk. II.



9·2" Mk. III.



9·2" Mk. IV.



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following technical defects which his previous experience had indicated :

"(1) Mountings were too cumbrous, this arising partly from the fact that

"(2) Recoils were unnecessarily long.

"(3) Arrangements for loading and for handling projectiles were inconvenient.

"(4) Sighting and its relation to training and elevating were unsatisfactory."[1]

As, further, the view previously set forth[2]—that the 9·2-inch and 6-inch guns should form the staple armament of coast defences—had come into favour, it was possible to concentrate effort upon these types. Plate XXVI. shows the resulting evolution of the 9·2-inch mounting, of which Marks III. and IV. were successive steps.

The Mark III. mounting is placed upon a cast-iron pedestal built up in two parts bolted together. By this means a large bearing surface upon the concrete foundation is secured, and at the same time the emplacement is not inconveniently filled up. The carriage is of simple construction, two brackets supporting the slide, being built up from strong bolsters. The buffers are similar in design to those of the 6-inch barbette, but the trunnions rest in ball bearings. The recoil is about 39 inches.

There is a training and an elevating gear at the left front of the mounting under full cover of the parapet and shield. The left sighting platform has both gears, and the right platform training gear only. A training arc and a special elevation indicator are provided, in full view of the numbers employed at the under-cover station. The laying number standing on either sighting platform can indicate by a

[1] "Mountings for Coast Artillery," by the writer. Proceedings of Royal Artillery Institution, 1897.

[2] 1st Edition, 1890.

pointer the direction in which he requires the gun to be traversed. As soon as the sight is approximately "on," however, he can halt the training numbers and complete the fine laying with his own gear.

All the operations of loading are performed on the emplacement floor. Shell stored on sabots under the front parapet are picked up by a barrow and wheeled up to the carrier A, into which they are tipped. The carrier is counterbalanced so that one man working the winch-handle, B, raises it with the projectile till it bears up against the breech of the gun elevated to 15 degrees. The projectile is then rammed off the carrier, which contains a loading tray on rollers entering the breech and held by a catch until the charge also has been rammed. The catch is then released, and the tray drops back into the carrier, which is immediately lowered. The projectile is thus never lifted by tackle, and one man easily takes it on to the barrow and tips it into the carrier, which can be elevated till a pawl engages a notch, which detains it in a position allowing the gun to recoil and the breech-block to be swung clear. A short further lift to a second notch brings the carrier into the loading position. As soon as the gun is sufficiently elevated, the opening of the breech begins, and is completed by the time the gun comes to rest. Similarly, the closing of the breech is effected as the gun is being depressed. There is thus no loss of time, and with untrained labourers the gun can be elevated, loaded, depressed to firing position and trained 60 degrees in fifty seconds. At the same time, all numbers are well protected, and only the laying number is raised above the emplacement level.

The demand for a mounting to allow 20 degrees depression provided an opportunity to introduce axial recoil, with the result of the compact arrangement Mark IV. (Plate XXVI.).

The gun trunnions are placed in cast-steel sliding pieces which move in a cast-steel cradle built up in four parts—two side and two end pieces, the latter being underneath the gun, and furnishing attachments for the air cylinder and the piston-rod head respectively. A sleeve formed in two pieces embraces the gun, and is provided with a lug below. The buffer cylinder is held by this lug, and its rear end enters the air cylinder through a liquid gland.

The gun in recoiling drives back the buffer cylinder, which, acting as a ram in the air cylinder, compresses the air to about 500 pounds per square inch. The gun is brought to rest in about 3 feet 6 inches by the buffer, and the air pressure in the cylinder immediately runs it out again subject to control by a rod attached to the end of the buffer cylinder, which enters a hollow in the piston-rod. The intensifier in connection with the air cylinder keeps the liquid gland in pressure, which increases during the recoil.[1] The pressure in the air cylinder with gun run out is about 200 pounds, which can be retained with little difficulty. By means of a small hand-pump, two men can easily restore lost pressure at the rate of about 1 pound per minute. There are no valves or complications, and in addition to the care of the ordinary buffer gland, to which there is free access by getting inside the cast-iron pedestal, it is only necessary to be able to make a packing capable of retaining the pressure. Training and elevation can be performed from the sighting platform, or from the emplacement floor. There are three training and two elevating stations.

The recoil arrangement above described having proved satisfactory, a further step could be taken by applying it to a trunnionless gun, by which means the design could be

[1] This recoil arrangement was first applied by Colonel T. English to a 10-inch H.-P. experimental converted mounting.

simplified. Mark V. (Plate XXVII.) is the last design of the writer. In this design the gun in recoiling carries with it two rams, which, moving in cylinders attached to the cradle, force liquid into a spring accumulator A, which can be placed in a chamber adjoining the emplacement. The hydraulic power thus stored is utilized for lifting the projectiles. For this purpose two hydraulic lifts are provided, one, B, in the emplacement floor, the other, C, attached to and moving with the mounting. Underneath and suspended from the circular gun-platform D D (1¼ inches steel) is an overhead railway, E E, on which run trolleys, F F, each supporting one projectile. The projectiles are stored in a recess, G, under the parapet, each standing on a wooden sabot. By means of a special shell-barrow any projectile can be wheeled into position over the hydraulic lift, B. By moving the hand-lever, H, the lift raises the projectile to the trolley above, where it is held in position by two hinged bands. The trolley can then be run round until it is over the other lift, C, where it is locked by a catch, J. The breech having been opened and a hinged loading tray being swung into it, the hand-lever K is moved, actuating the lift C, which thus raises the projectile into position to be rammed home. The loading of trolleys by means of the lift B can proceed whatever is the position of the gun, so that two or three of them can always be in readiness to be brought under the breech. Empty trolleys pass round the overhead railway to be reloaded. In this way manual labour is reduced to a minimum, and the lifting of the projectile is done entirely by hydraulic power automatically stored. If the automatic system is injured, the accumulator pressure can be maintained by working the hand-pump L. If the hydraulic connection is severed, the projectiles must be wheeled in barrows on the emplacement floor and brought under the swinging derrick

RK V)

Plate XXVII.

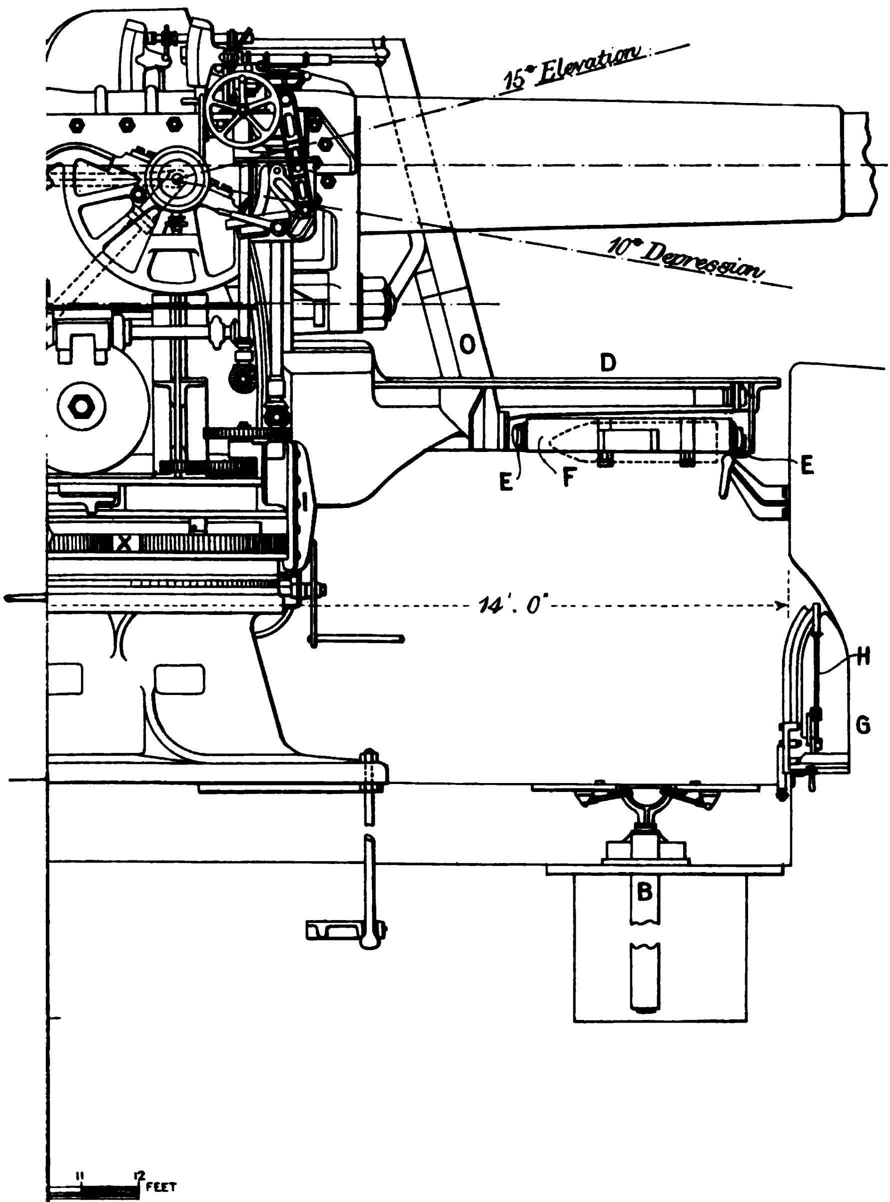

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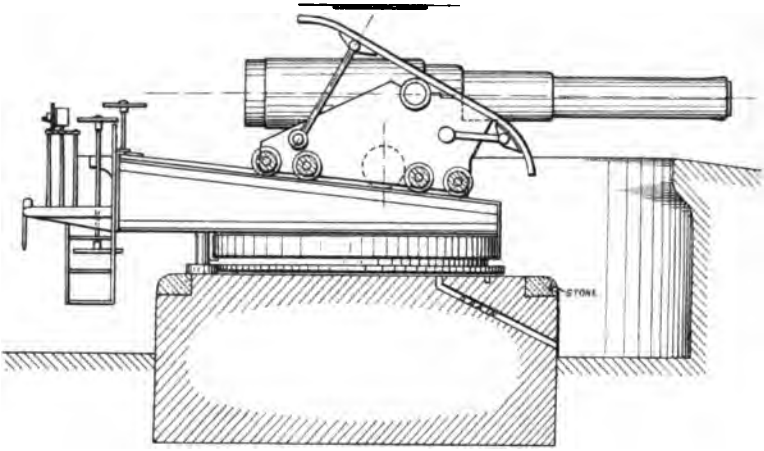
DIAGRAM
— SHOWING —
EVOLUTION OF 6 IN MOUNTINGS.

Plate XXVIII.

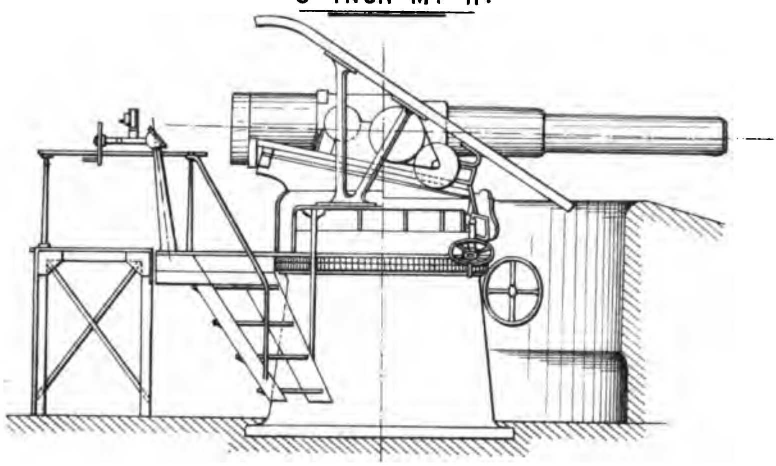
— Scale. —

0 1 2 3 4 5 6 7 8 9 10 11 FEET.

6 INCH MK I.

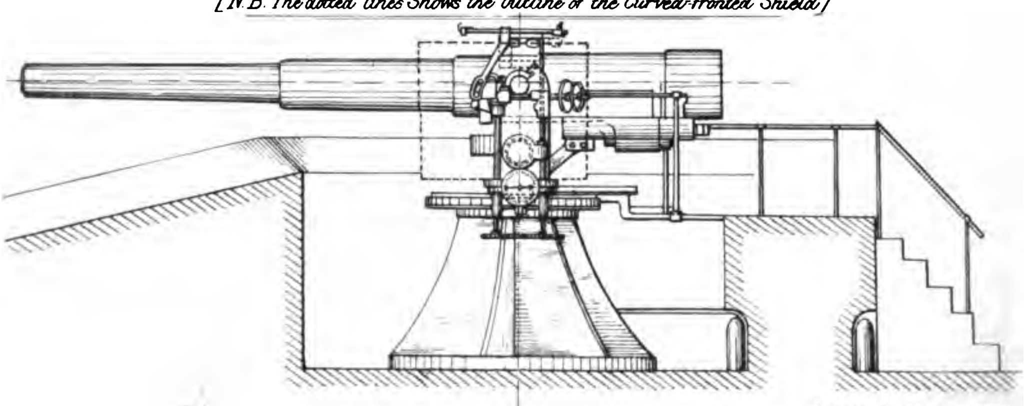


6 INCH MK II.



6 INCH Q.F. MARK II.

[N.B. The dotted lines Shows the Outline of the Curved-fronted Shield]



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M, being then raised by a Weston differential tackle and dropped into the loading-tray.

The gun can be trained and elevated from the emplacement floor, and also from the sighting platforms N, quick gear being used in the first case and slow in the second. The maximum rate of fire is approximately three rounds per minute. A 6-inch steel shield, O, with side-wings, and two 4-inch shields as a protection to the recoil cylinder against splinters, are provided.

The evolution of the 6-inch mounting is shown in Plate XXVIII. The first step taken (Mark II.) was to shorten the recoil and place the mounting on a cast-iron pedestal. Alternative training and elevating arrangements were provided. The next step was to introduce axial recoil, which had for some time been in use in the Navy. This led in the case of trunnionless guns to the form shown as 6-inch Q.F., Mark II. (Plate XXVIII.), which lent itself admirably to the high-power 6-inch B.L. Mark VII. gun, then about to be introduced.

As the naval pivot did not suit the requirements of a land service mounting, a different arrangement was necessary. A vertical forged steel pivot-post is dropped into a cast-iron pedestal, from which it projects, having at the top a circular recess containing steel balls. The carriage is a steel casting of U form, providing a socket below, which fits over the pivot. Thus the gun and cradle are simply hung upon the pivot, the weight being taken by a steel cover-plate, which rests on the balls. By depressing the gun and loosening the screws in the cover-plate the weight of the gun and carriage comes directly on the pedestal. The plate can then be removed, and access to the balls is obtained at any time without dismounting the gun. Training and elevating can be performed under cover from the emplacement floor, or by the gun-layer on the sighting

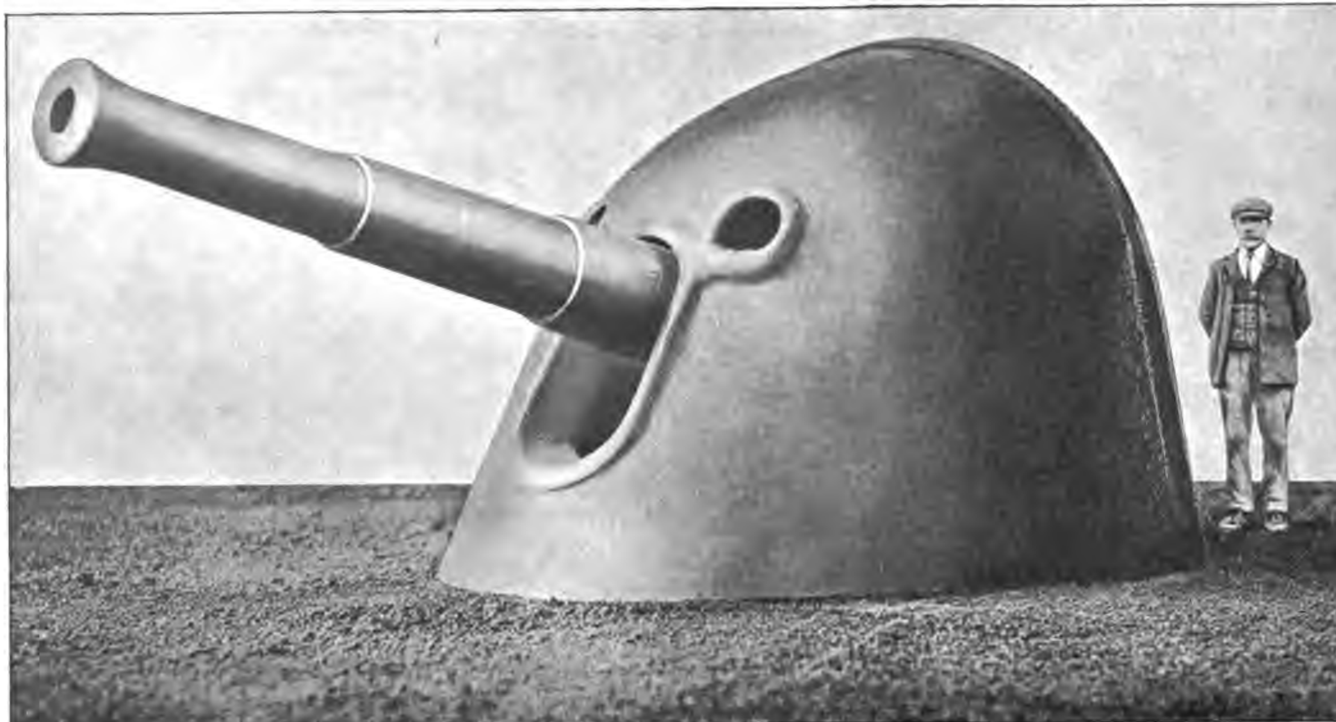
platform. A curved steel shield provides protection from splinters. With this mounting a speed of fire of seven rounds per minute can be obtained with the 6-inch B.L. Mark VII. gun.

In connection with the mountings above described, the writer designed a system of auto-sighting, and as the full advantages of an auto-sight cannot be realized without the employment of a telescope, it was possible to overcome the previous objections to this alleged complication. The result has been to add largely to the speed and accuracy of fire of coast-defence guns. The gun is now its own depression range-finder, and excellent practice can be made even from comparatively low sites. Incidentally, changes in what may be called the tactics of coast defence are being brought about. The gun has become a self-contained unit, independent of external aid for accurate fire. In these circumstances, the earlier idea of manipulating a considerable armament by electrically worked dials or signals from a central observing station could only lead to a wholesale loss of opportunities which will frequently be transient.[1] While, therefore, some general control may be required in special cases, it will, as a rule, be advisable to give the freest hand to the group commander, who must be best able to select his target. Coast-defence guns can now deliver rapid and extremely accurate fire, of which the fullest advantage should be taken.

There is no finality in the designs of mountings for coast Artillery, and those above described will in due time be superseded by better arrangements. The shields are far from satisfactory; but the curved forms required could not at the time be obtained in hard-faced armour, or would have been inordinately expensive. Already, however, Mr. R. A. Hadfield has succeeded in producing an excellent

[1] See p. 258.

Plate XXIX.



"Era" Cast Steel Shield for 6-inch Gun.

[To face page 203.

cast steel, which has given surprising results in firing trials, and lends itself exactly to the requirements of coast Artillery. Plate XXIX. shows a shield of "Era" steel made for a 6-inch mounting, and serves to illustrate the adaptability of form which is now available. The protection of the 9·2-inch mounting (Plate XXVII.) might be improved by the use of this cast steel. If power, such as electricity, from an external source can be applied, simplification of design, combined with a great reduction of labour and a higher speed of fire, becomes possible. Future progress may lie in this direction.

CHAPTER XV

THE EVOLUTION OF BATTLESHIPS AND CRUISERS—FOREIGN SHIPS

BATTLESHIPS.

As an intimate acquaintance with the capabilities and the disabilities of warships is an essential part of the equipment of officers who may have to design or to fight coast batteries, a brief sketch of the evolution of the armoured vessel must be regarded as a necessary part of a work dealing with coast Fortification.

The first proposal to apply armour to naval purposes seems to have been made by John Stevens, of New Jersey, in 1812, and was doubtless suggested by the war between Great Britain and the United States which began in that year. In 1827 and in 1840 experiments were made in this country which led to no results, and when the Crimean War broke out in 1854, the line of battle ship was practically the same as that of Nelson's day, with the addition, then commencing, of auxiliary steam power.

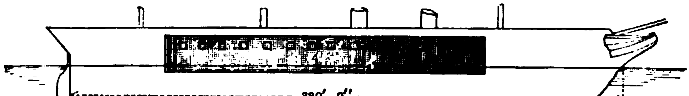
During the long peace, however, there had been improvements in guns and in projectiles. Previous experience might have served to indicate what would happen; but the teaching of war is frequently forgotten or ignored, and the fact that six British ships were put out of action on the 17th October, 1854, mainly by the shell fire of such wretched works as the Telegraph and Wasp batteries came as an

unpleasant surprise. The French at once set about the construction of three armoured batteries, which were employed with effect at Kinburn in 1855. Great Britain also constructed similar vessels, protected by 4½-inch iron plates, carrying fourteen 6-pr. guns, and provided with engines of 700 h.p. Meanwhile, John Ericsson and Captain Cowper Coles were independently engaged in planning "cupola ships." The former, on the 26th September, 1854, sent a sketch design of an armoured monitor to Napoleon III., who thought that "the result to be obtained would not be proportionate to the expense or to the small number of guns which would be brought into use"; the latter carried out experiments with rafts in the Sea of Azoff.

From these small beginnings sprang a long series of designs, which, successively modified by the growing power of the gun and by the improvement in steel manufacture, have led to the battleship and armoured cruiser of the present day

Evolution of the Broadside Ship.

In 1858 France commenced the construction of four armoured frigates—*Gloire*, *Normandie*, *Invincible*, and *Couronne*—Great Britain quickly following with the *Warrior*



WARRIOR

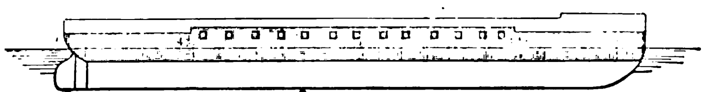
(1859),[1] *Black Prince*, *Defence*, and *Resistance*. The French from the first extended the protection to the whole waterline, and have since shown marked preference for this system. The *Warrior* and her consorts, on the other hand, were

[1] The dates given are those of the commencement of the ships.

armoured (4½ inches) over a little more than half the length.[1]

In the *Hector* and *Valiant* (1861) the 4½-inch armour was extended to cover the whole armament, leaving the ends unprotected.

In the *Achilles* (1861) the water-line belt was extended from end to end, and was heightened for more than one-half the length to cover the battery.



ACHILLES

Meanwhile rifled guns, which had been employed experimentally in the trenches before Sebastopol,[2] were rapidly coming into general use, and the need for increasing the thickness of armour at once arose. Thus, the *Minotaur* (1861) and the *Agincourt* (1862) had 5½ inches on the side. Guns increasing in size, and armour in thickness, the former were grouped in order to diminish the area covered by the latter, as in the case of the *Bellerophon* (1864), with 6 inches of iron over belt and battery, and the *Hercules* (1866) with 9 inches on the belt and 8 inches to 6 inches on the battery.

In the *Sultan* (1868), the *Invincible* and *Iron Duke* (1867), the *Audacious* (1867), and the *Swiftsure* and *Triumph* (1868), an upper-deck battery was provided to give increased gun power.

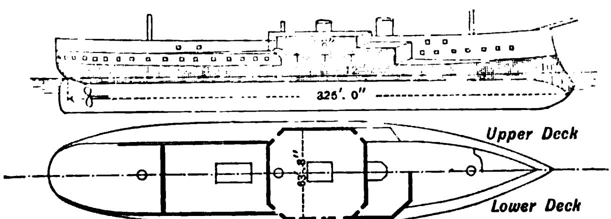
This general form of construction was continued, and culminated in the *Alexandra* (1873), which had a 12-inch

[1] Armour was not confined to new constructions, and some large uncompleted wooden vessels of old type were provided with 4½-inch plating at this period, the additional weight being balanced by a reduction in the number of guns.

[2] In the "Lancaster" battery on the Victoria Ridge, which played a part in the battle of Inkermann.

to 10-inch belt and an upper and a main deck battery, mounting six guns on the broadside, and four guns firing ahead or astern, all behind 8 inches of armour.

With the *Alexandra*, the pedigree of the broadside armour-clad may be said to have come to an end. The persistence of the type for nearly twenty years was probably due to



ALEXANDRA

the belief, which lingered till a later date, that sails were a necessary supplement to steam power, to the want of sea-worthy qualities in the earlier turret ships, and also to the fact of guns heavier than 18 and 25 tons not having been introduced.

The evolution of the broadside ships thus followed the following lines: The " origin of the species " was the desire to obtain protection against shell fire from coast defences, and the *Warrior* and her sisters were practically old-type frigates patched with iron on their sides. The struggle for existence, as gun power steadily developed, produced first the combined continuous belt and armoured battery, then the central battery with a complete belt. The battery, after having shrunk in the *Bellerophon* and *Hercules*, was sub-divided in the *Alexandra*. At the same time, the total area and armament protected by armour tended to diminish, and the proportion of weight of armour to displacement rose from 1 : 6·38 in the *Warrior* to 1 : 4 in the *Alexandra*. The gun still acquiring greater power, the attempt to give complete protection to water-line and armament on these

lines was abandoned, and the era of the broadside ironclad passed away.

Meanwhile, the difficulty of providing adequate protection for the broadside vessel had given rise to another method of shipbuilding which developed on parallel lines.

Evolution of the Cupola Ship.

The earliest designs of Ericsson and of Cowper Coles contemplated a turret of spherical form ; but difficulties of construction apparently led both to adopt a cylindrical outline. The original *Monitor* of 776 tons with a single turret was built and under steam in a hundred working days, and fought her memorable action with the broadside *Merrimac* (*née Virginia*) on the 9th March, 1862. The *Monitor* proved absolutely suited to the special needs of the moment, and, as usual in such cases, generalizations followed which were wholly unjustified. The glamour of the action in Hampton Roads continued for many years to influence shipbuilding in the United States, and even in 1898 Admiral Sampson found himself heavily handicapped by the presence of monitors in the squadron which he took to San Juan, Puerto Rico.

In 1860, Captain Coles produced a design for a turret ship cut down from a three-decker, and the *Royal Sovereign*, which had been under construction since 1855, was at length selected for this treatment. . This, the first British cupola ship, armoured with 5½ inches of iron and carrying four turrets, was successfully tried in 1864, and was, for all general purposes of war, an infinitely more powerful vessel than the *Monitor*. The *Prince Albert*, a similar ship, was completed about the same time.

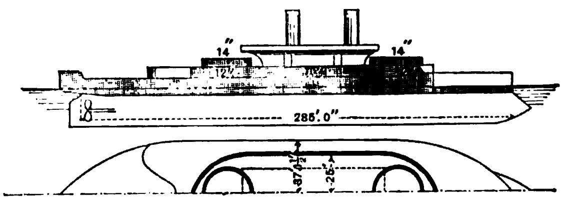
The *Royal Sovereign* was followed by the *Monarch* (1866), of 8,322 tons and 14·9 knots speed, with 7-inch to 5-inch armour on the side and 10-inch to 8-inch on two turrets,

each containing two 25-ton guns. In addition, there were two 12-ton guns in the bows and one 6½-ton gun at the stern.[1]

With the *Captain* (1867), which capsized in the Bay of Biscay on the 6th September, 1870, the idea of giving sail power to a low free-board turret ship came to a tragic end.

The *Abyssinia* Class (3), of 2,900 to 3,480 tons, speed 9½ to 10½ knots, with 8-inch to 6-inch armour on side and 10-inch to 9-inch on two turrets, mounting each two 18-ton guns, was begun in 1868. This class, intended for coast defence only, is an instance of retrogression of which there have been subsequent examples.

The *Devastation* and *Thunderer* (1869) mark a great advance to the type of a powerful sailless seagoing battleship,



DEVASTATION

of 9,330 tons and 13½ knots speed, with a complete armour belt 12 inches to 10 inches and 14 inches to 12 inches on two turrets, mounting two 38-ton and two 35-ton guns[2] respectively. These vessels were also provided with an armoured deck, 3 inches to 2 inches, placed on the top of the belt, and with athwartship bulkheads carried down below the belt, and affording protection to the magazines when the ship was pitching. The *Dreadnought* (1870) is similar in design, but has side armour 14 to 11 inches.

[1] Meanwhile the United States had constructed the ***Miantonomoh***, which crossed the Atlantic in 1866, causing the *Times* to declare that our whole Navy had become useless, and was only fit to be laid up and "painted that dirty yellow colour which is universally adopted to mark treachery, failure, and crime."

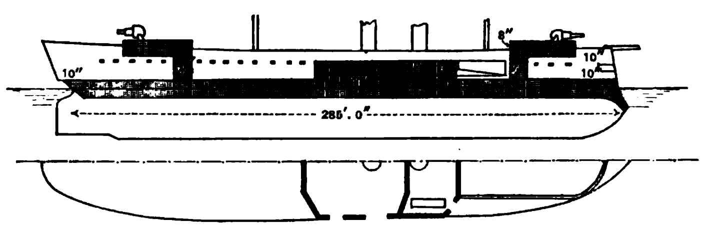
[2] Originally all 25-ton guns.

The armament of these ships was subsequently altered to four 10-inch B.L. guns, and with new engines their speed was increased to 14 knots. The general conception embodied in this type was distinctly superior to some later designs, and the *Devastation* Class were still formidable when subsequent ships were only fit for the scrap-heap.

The *Glatton* Class (5), begun in 1869, marks another backward step. These vessels were built for coast defence, and were small editions of the *Thunderer*, being from 3,500 to 4,800 tons, with 11 to 12 knots speed, and 8-inch to 6-inch armour on the side and 10-inch to 9-inch on two turrets, each containing two 18-ton guns. The *Glatton* herself, however, had 12-inch to 10-inch on the side and one turret (14-inch), containing two 25-ton guns. These vessels might possibly have been employed for the attack of coast defences, but were otherwise unsuited to British requirements.

Combination of the Broadside and Turret Ship.

The *Téméraire* (1874) is particularly interesting as a new departure, combining the features of the broadside and the turret ship, which was destined to develop into a type which has lasted to the present day. A barbette at each end



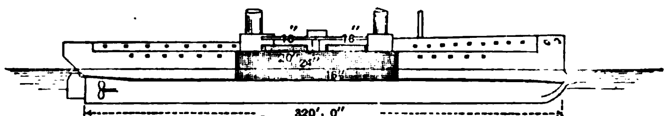
TÉMÉRAIRE

carried a 25-ton gun on a disappearing mounting, and a divided central battery was armed with four 18-ton guns and two 25-ton guns in angle ports forward. There was a complete belt 11 to 10 inches; the barbettes had 10-inch and

8-inch armour, the central battery 8-inch, and the ammunition hoists 7½-inch. There was thus a broadside fire of three 25-ton and two 18-ton guns, and a bow fire of three 25-ton guns.

Further Evolution of the Turret Ship.

Under the influence of megalomania and Italian inspiration, ship design now took a distinctly retrograde step in the *Inflexible* (1875), of 11,880 tons. The side armour (24 inches, 20 inches, and 16 inches) shrank suddenly to one-third of the length—a reversion to the *Warrior* Two



INFLEXIBLE

turrets, *en échelon*, with 16-inch armour, contained each two 80-ton guns. An armoured deck (3 inches) was placed some distance below the water-line throughout the unprotected ends. The speed was 13·8 knots. Thus there was a great increase of thickness of armour, which could therefore be applied only to a small portion of the ship. The armament was exceptionally heavy, and it seems to have been thought necessary to protect it by a corresponding increase of armour, irrespective of other considerations.

The *Agamemnon* and *Ajax* (1877), of the same type, but only 8,510 tons displacement, followed. The armament was reduced to four 38-ton guns, and the armour to 18 inches to 15 inches on the side, and 16 inches to 14 inches on the turrets. Two 6-inch B.L. guns, without protection, were added as secondary armament.

The *Colossus* and *Edinburgh*, of 9,150 tons and 15½ knots speed, followed, with four 45-ton B.L. guns, 18-inch to 14-inch armour on the side over three-eighths of the length,

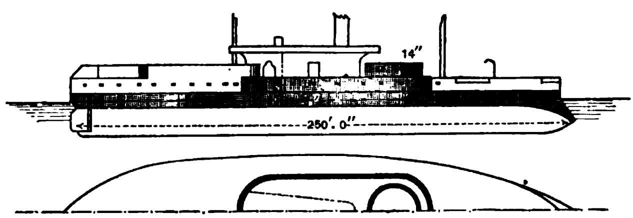
and 16-inch to 14-inch on the turrets. The auxiliary armament was increased to five 6-inch B.L. guns unprotected.

The *Inflexible* type, which was thoroughly bad in conception, now happily came to an end.

EVOLUTION OF THE SINGLE-TURRET SHIP.

The evolution of the single-turret ship was unbroken from the *Hotspur* (1864) to the *Victoria* and *Sanspareil*, with which it ended.

The *Hotspur*, of 4,010 tons, had a continuous belt 11 inches to 8 inches, and a citadel 8 inches, carrying a turret 10 inches to 8½ inches. The armament consisted of two 25-ton guns and two 64-pounder guns unprotected. The *Rupert* (1870), of 5,140 tons, had 11-inch to 9-inch side and 14-inch to 12-inch turret armour. The turret contained two 18-ton guns, and there was, in addition, two 64-pr. guns un-

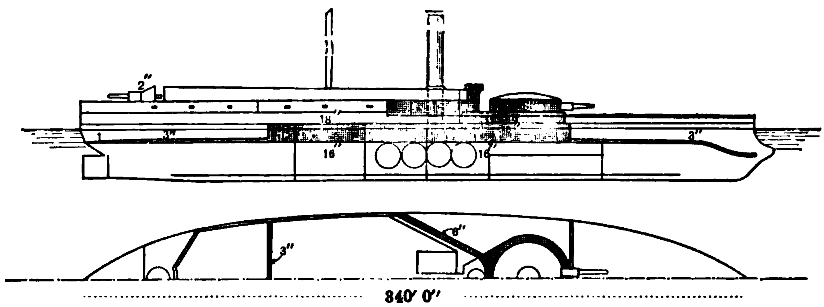


RUPERT

protected. The *Conqueror* (1879) and the *Hero* (1884), of 6,200 tons, the belt 12 inches to 8½ inches, stopped short (26 feet) of the stern, and was continued aft by a 2½-inch deck. The turret (11½ inches) contained two 12-inch B.L. guns. Four 6-inch guns without protection were added as secondary armament.

In the *Victoria* and *Sanspareil* (1885) the belt (18 to 16 inches) extended over considerably less than half the length, and was prolonged fore and aft by a 3-inch under-water deck. Above the forward end of the belted section was a redoubt

(18 inches), on which stood the turret (18 inches), mounting two 110-ton B.L. guns. For stern fire a 10-inch B.L. gun was added, apparently as an afterthought. The auxiliary armament consisted of six 6-inch B.L. guns on each broad-



SANSPAREIL

side, protected by side armour (3 inches), and forward by splayed bulkheads (6 inches). The battery was divided by a 3-inch athwartship bulkhead.

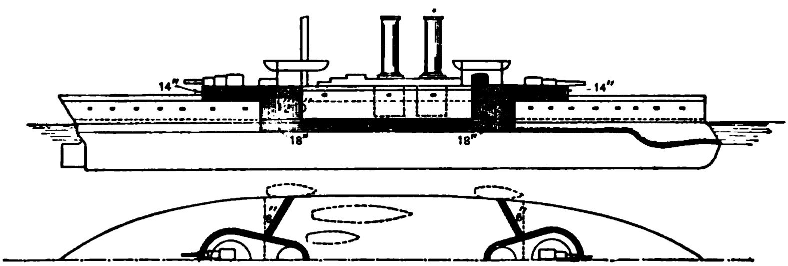
The *Victoria* and *Sanspareil* were the lineal descendants of the single-turreted ships of the *Hotspur* type, increased in dimensions to enable them to carry the two 110-ton guns, to which all other considerations were sacrificed. Unless these ships could have quickly succeeded in rendering an antagonist *hors de combat* by means of their two heavy guns,[1] they would have been rendered unmanageable, or sunk by the shell fire of medium ordnance. The persistence of the single-turreted type, until it practically reached a *reductio ad absurdum*, is somewhat remarkable.

Evolution of the Combined Turret and Broadside Ship.

The evolution of the combined turret and broadside ship which was interrupted by the intrusion of *Inflexibles*, now commenced, but on two distinct lines, to be afterwards united.

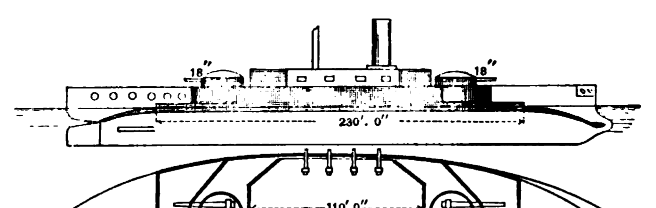
[1] These guns could not fire over an arc of about 90 degrees astern.

Thus the *Admiral* Class (6), begun 1882-83, and launched from 1886-89, were of 9,500 to 10,600 tons, with 16·5 to 17·4 knots speed. Following the *Téméraire*, the heavy guns were mounted forward and aft in barbettes, with an auxiliary broadside armament in a central battery, unpro-



COLLINGWOOD

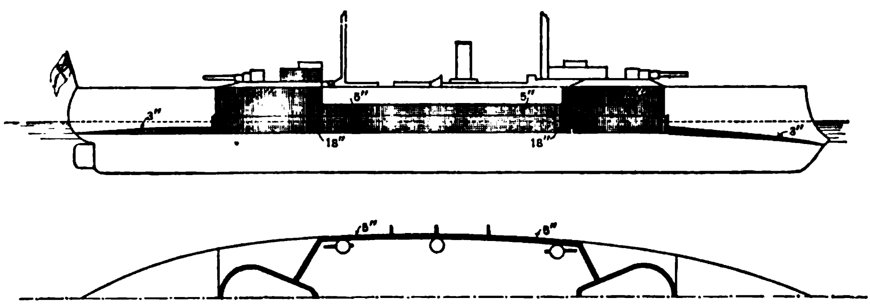
tected except by bulkheads. One *Admiral* carried four 45-ton and six 6-inch guns; four carried four 67-ton and six 6-inch guns; and one carried two 111-ton and ten 6-inch guns. The belt (18-inch compound) extended over about two-fifths of the length, and the barbette armour was 14-inch to 12-inch compound. Armoured ammunition hoists were provided for the heavy guns, but the main supports of the massive barbettes and of their armament were unprotected. There was an under-water armoured deck (3 to 2½ inches) forward and aft of the belt.



NILE

While this very unsatisfactory class was in progress, two ships differing from it materially in conception were constructed. In the *Nile* and *Trafalgar* (1885) the principal

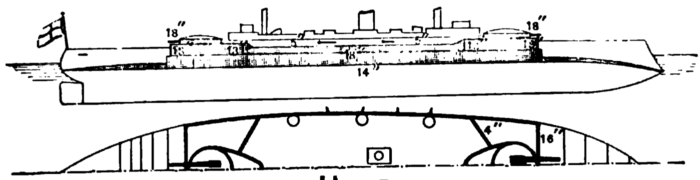
features of the *Dreadnought* were repeated. The tonnage was 11,940 and the speed 16·7 knots. The heavy armament (four 67-ton guns) was placed in two turrets, and a secondary armament of six 4·7-inch Q.F. guns in a central battery was added. The belt (20-inch to 16-inch compound) extended at the water-line over 230 feet out of a total length of 345 feet. The turrets (18-inch compound) stand upon a citadel (18 inches to 16 inches on sides, 8-inch curved bulkheads at ends) carried up to the upper deck. The central battery above the citadel has 5-inch end bulkheads and 3 inches on the sides. An armoured deck (3 inches) extends over the unbelted ends and the citadel. The protection of these two ships was, therefore, distinctly superior to that of the *Admirals*, which were exposed to dangerous injuries from the fire of medium guns.



ROYAL SOVEREIGN

The *Royal Sovereign* Class (8), begun in 1889, combines some of the features of the *Nile* and of the *Admirals*. The tonnage is 14,150, the speed 17·5 knots. The heavy armament (four 67-ton guns) is placed in barbettes with 17 to 16-inch compound armour (except in the *Hood*, which has turrets); and the secondary armament of ten 6-inch Q.F. guns is dispersed, four in casemates (6 inches) on the main deck, and six on the upper deck with shields, afterwards changed to casemates. The *Royal Sovereigns* are still powerful vessels, distinctly superior to contemporary foreign ships.

The belt (18 to 14 inches) extends over three-fifths of the water-line length, and above it, up to the main deck, the armour is 4 inches. There is a 3-inch armoured deck over the belted portion, and 2½ inches over the unprotected ends.



HOOD

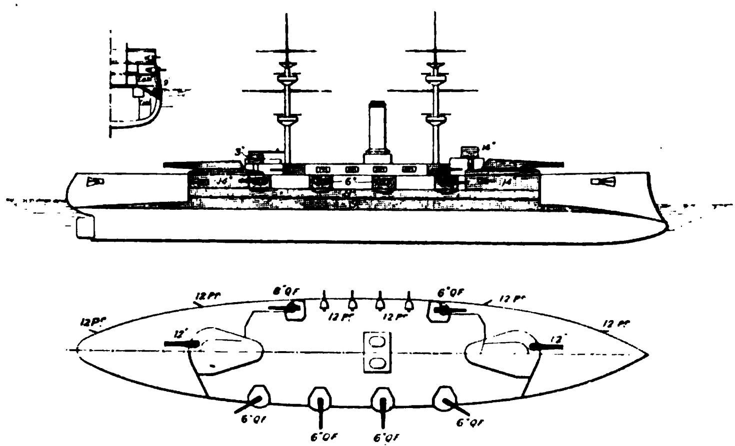
The *Centurion* (1890) and *Barfleur* (1891), of 10,500 tons and 18·5 knots speed, closely resemble the *Royal Sovereign* Class on smaller dimensions. The armament consists of four 29-ton 10-inch guns in turrets, with 6-inch front and side armour, and ten 6-inch Q.F. guns in 5-inch casemates.[1] The belt (12 to 9 inches) covers about five-ninths of the length, and the barbettes are 9 inches, the side armour about the belt being 4 inches. This type was the outcome of a desire to obtain a small battleship capable of passing through the Suez Canal for service in the Far East. Hitherto the turret, following its progenitor, had been circular in form. In the *Centurion* and *Barfleur*, however, the heavy guns, firing over fixed armoured barbettes, were protected by armour fitted to and revolving with them, and sloped in front. The fixed armour upon which the new form of turret revolves retains the title "barbette."

The *Renown* (1892), of 12,350 tons and 18 knots, was a development of the *Barfleur*, with the same armament. Harveyized armour was employed—8 inches on the belt, 6 inches above the belt, 8 inches on the turrets, and 10 inches on the barbettes. The armoured deck (2 inches) covering the

[1] Originally twelve 4·7-inch; rearmed 1902-03.

belted portion was for the first time sloped to meet the lower edge of the belt, and increased to 3 inches on the slope.

The *Majestic* Class (9), of 14,900 tons and 17·5 knots (begun in 1894), is an evolution from the *Royal Sovereigns*, embodying some features of the *Renown*. The armament consists of four 12-inch guns in turrets and twelve 6-inch Q.F. guns in casemates. The protection is—belt 9 inches, covered by a sloping deck 4 inches to 3 inches; turrets 10 inches, and barbettes 14 inches; casemates 6 inches; side armour above belt 9 inches; armoured deck 2½ inches before and abaft the belt.

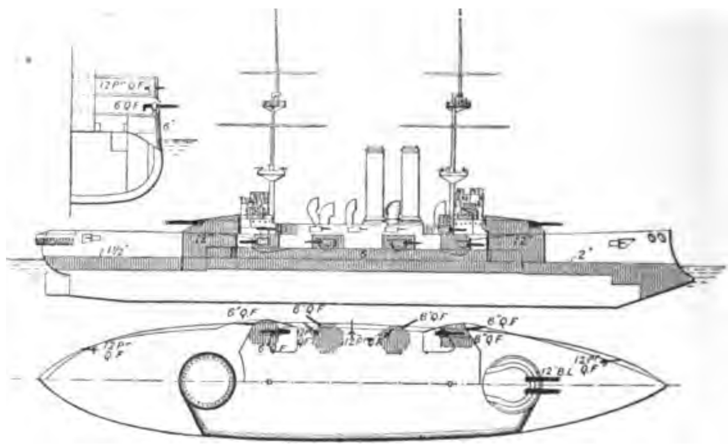


MAJESTIC

In the *Illustrious* and *Cæsar*, of the *Majestic* Class, improvements in the loading arrangements of the heavy guns enabled circular barbettes to be substituted for the pear-shaped form previously employed.

The *Canopus* (6) Class (1897-99), of 12,950 tons and 18·5 knots, denotes a reversion to smaller displacement, and a reduction of belt and side armour to 6 inches. These ships show the influence of the advent of high explosive shells. There are two armoured decks—one (1 inch) at the line of

the upper edge of the side armour; and the other (2 inches not sloped) on the line of the upper edge of the belt. Before and abaft the belt there is a 2-inch deck, and in addition the bow is protected by 3-inch side armour.



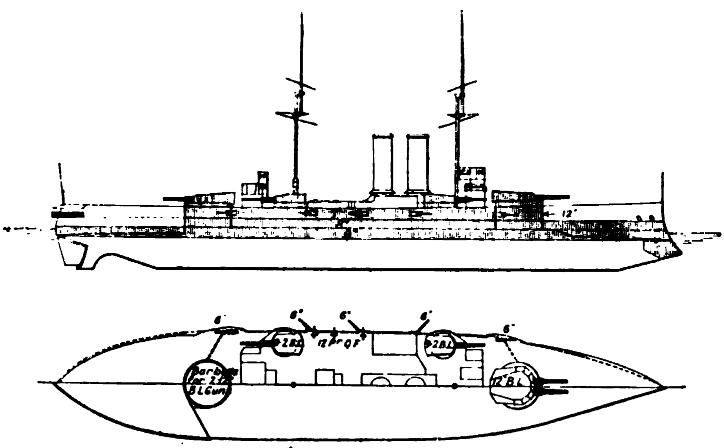
CANOPUS

The *Formidable* Class (8), of 15,000 tons and 18 knots speed (1898-1902), follows generally the design of the *Majestic*, embodying features of the *Canopus* class. The belt and side armour (9 inches) extends over three-fifths of the length. In the *Formidable*, *Implacable*, and *Irresistible*, the side armour forward of this belt is similar to that of the *Canopus* class. In the five remaining ships the side armour forward is graduated from 7 to 3 inches. All the *Formidables* have side armour (1½ inches) in addition to a 2½-inch deck carried to the stern. The thin belt aft appears to have been introduced not as a protection against shell fire, but in consequence of an accident in the Mediterranean, when a torpedo-boat's stem struck a battleship abaft of the belt, flooding her after-part. To provide against this, the *Canopus* class were sheathed in wood, for

which thin armour was substituted in the *Formidables*. The whole Class has two armoured decks between the barbettes, as in the *Canopus*; but the lower deck is sloped and increased to 3 inches. Before and abaft the belt there is a 2-inch deck.

In the *Duncan* Class (6), of 14,000 tons and 19 knots (1899), the belt and side armour is reduced to 7 inches, tapering from 5 inches to 3 inches at the bows. The barbettes are reduced in diameter, and their armour is 11 inches, reduced to 10 inches on the side towards the centre of the ship.

The *King Edward* Class (8), of 16,350 tons and about 19 knots (1902), mark a new point of departure, four 9·2-inch

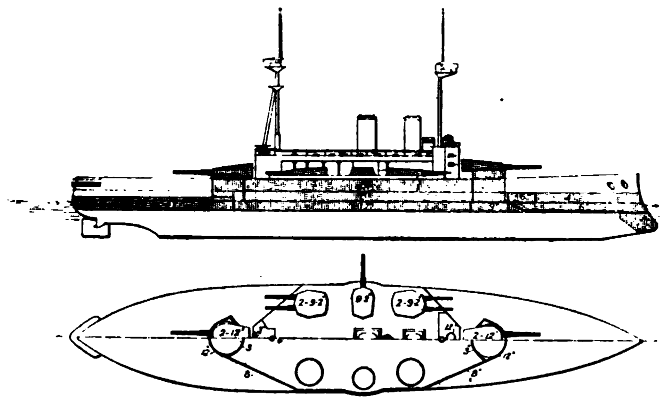


KING EDWARD VII

guns in single turrets on the upper deck being introduced into the secondary armament in addition to ten 6-inch guns on the main deck. The side armour (8 to 7 inches) is carried up to the upper deck, and the belt (9 inches) tapers to 3 inches at the bows (where it is carried up to the main-deck level), and to $1\frac{1}{2}$ inches at the stern. The turrets of the 12-inch guns have 8 inches armour.

The *Lord Nelson* (1905) and *Agamemnon*, of 16,750 tons

and 18 knots speed, follow the *King Edward* Class; but the secondary armament is increased in size to ten 9·2-inch guns, of which eight are in pairs and two singly in turrets. The 6-inch guns are suppressed, and all the eight turrets are mounted on the upper deck. The disposition of the armour is practically the same as in the *King Edward* Class;



LORD NELSON

but the thickness varies somewhat, as indicated in the figure.

In the *Dreadnought*[1] (1905) the secondary armament disappears, and ten 12-inch guns are mounted in five turrets, of which three are on the line of the keel and two are athwartships forward.

In the diagram an attempt is made to show the evolution of the armoured battleship in pedigree form.

CRUISERS.

The evolution of the cruiser is as difficult to trace as that of the battleship. The frigate and corvette of Nelson's day had definite functions which were thoroughly under-

[1] The genesis of the *Dreadnought* may apparently be traced to a design by Colonel Cuniberti.

THE EVOLUTION OF BATTLESHIPS.

Date. **Wooden Line of Battle Ships.**

Broadside Type (Crimean War) — Turret Type (Ericsson and Capt. Cowper Coles)

1859. **Warrior,** 40 68-prs.
1861. **Minotaur,** 17 7½-ton .... **Royal Sovereign,** 8 9-ton — (Single Turret)
1864. **Bellerophon,** 10 12-ton, 4 64-prs. .... **Prince Albert,** 8 9-ton .... **Hotspur,** 1 25-ton 2 64-prs.
1866. **Hercules,** 11-18 ton, 2 12½-ton, 4 6½-ton ...... **Monarch,** 4 25-ton, 2 12-ton, 1 6½-ton
1867. ... . **Captain,** 4 25-ton
1868. **Sultan,** 8 18-ton, 4 12½-ton .... (Coast Defence) **Abyssinia,** 4 18-ton
1869. ... . **Devastation,** 4 25-ton ..... **Cyclops,** 4 18-ton — (*Type ends*)
1870. ... . **Dreadnought,** 4 38-ton ...... *Italian Design* .... **Rupert,** 2 18-ton 2 64-prs.
1873. **Alexandra,** 2 25-ton, 10 18-ton
1875. ... ... **Téméraire,** 4 25-ton, 4 18-ton .... **Inflexible,** 4 80-ton
1877. ... . **Ajax,** 4 38-ton, 2 6″
1879. ... . **Colossus,** 4 12″, 5 6″ .... **Conqueror,** 2 12″, 4 6″
1882. .... **Admiral Class,** 4 12″, 6 6″, or 4 13·5″, 6 6″, or 2 16·2″, 10 6″
1885. .... **Nile,** 4 13·5″, 8 5″ .... **Sanspareil,** 2 16·2″, 1 10″, 12 6″ — (*Type ends*)

(Large Battleships) — (Smaller Battleships)

1889. **Royal Sovereign,** 4 13·5, 10 6″
1890. .... **Barfleur,** 4 10″, 10 6″
1892. .... **Renown,** 4 10″, 10 6″
1894. **Majestic,** 4 12″, 12 6″
1897. .... **Canopus,** 4 12″, 12 6″
1898. **Formidable,** 4 12″, 12 6″
1899. .... **Duncan,** 4 12″, 12 6″
1902. **King Edward,** 4 12″, 4 9·2″, 10 6″ .... *Italian Design*
1905. **Lord Nelson,** 4 12″, 10 9·2″

Dreadnought, 10 12″

N.B.—Upright lines denote direct descent; transverse lines indicate the amalgamation of features of two types to produce a new species.

stood, and which lay outside the line of battle. The tonnage and armament of the former tended to become stereotyped as the result of the long experience of the wars of the French Revolution and Empire. Misconceptions, arising out of the war with the United States in 1812-14, led to the construction of exaggerated frigates, in which the cruiser and the battleship were blended, and this obliteration of the cruiser idea has since been repeated.

Omitting minor divergencies from type, the evolution of the cruiser may be said to have followed three main lines (see diagram):

1. Vessels without side armour, but provided after 1879 with protective decks, and later with protection for the armament—"protected cruisers."

2. Vessels carrying side armour protecting the armaments, and provided in later designs with protective decks—"armoured cruisers."

3. Cruiser battleships, apparently constructed to fulfil special requirements.

1. Evolution of the Cruiser without Side Armour.

These cruisers descend direct from the sailing-frigates and corvettes, iron construction being first adopted in the *Arethusa*, laid down in 1880, sails being abolished. In 1879 the *Polyphemus* was laid down as a ram. This unique vessel had a very low free-board, which could be further reduced by filling ballast tanks. As in the Italian *Lepanto*, of nearly the same date, the upper deck was armoured and sloped to a level below the normal water-line, thus providing height in the centre of the ship for engine space, and obviating the necessity for thick armour. The *Polyphemus*, happily, did not become a type; but the important principle

of an armoured deck sloping at the sides and ends was soon largely adopted.

Thus the *Arethusa* Class of cruisers (4) commenced in 1880 were of 4,300 tons and 16·4 knots speed, with machinery and magazines protected by a sloping armoured deck (1½ inches). The armament consisted of ten 6-inch guns. The *Mersey* Class (4) followed, of 4,050 tons and 17 knots speed, protected from stem to stern by a 2-inch to 3-inch sloping deck, and carrying two 8-inch and ten 6-inch guns.

In the *Blake* and *Blenheim* (1889) the thickness of the armoured deck on the sloped portion was increased to 6 inches for nearly half the length, and is nowhere less than 2 inches. These vessels were of 9,000 tons and 21·5 knots speed, with an armament of two 9·2-inch guns with 6-inch armour, four 6-inch guns on the main deck in 6-inch casemates, and six 6-inch guns on the upper deck with shields.

The Naval Defence Act of 1889 was wisely preceded by a general review of shipbuilding policy, which led to the construction of nine first-class and thirty-three second-class cruisers. The *Sirius* Class (10) were of 3,600 tons and 19·4 knots speed, with a 1-inch to 2-inch protection deck, and an armament of two 6-inch and six 4·7-inch Q.F. guns behind 4½-inch shields.

The *Edgar* Class (9), 1889-1890, are of 7,350 tons and 19·9 knots, with a protective deck 2 to 5 inches and an armament of two 9·2-inch and ten 6-inch Q.F. guns behind 6-inch shields.

The *Powerful* and *Terrible*, commenced in 1894, were apparently intended as a counterpoise to the Russian *Rurik*, high speed and large coal capacity being therefore required. They are of 14,200 tons and 22 knots speed, with protective decks 2 to 6 inches, and an armament of two 9·2-inch behind 6-inch shields, and twelve 6-inch guns in 6-inch casemates. The Russians promptly responded

by building the *Rossia*, with a 4-inch belt of Krupp steel and an armament of four 8-inch and sixteen 6-inch guns.

In the *Diadem* Class (8) of 1895 the tonnage and speed were 11,000 and 20·6 knots respectively. The protective decks varied from 2½ to 4 inches, and the armament consisted of sixteen 6-inch guns in 6-inch casemates, with the exception of two forward and two aft behind 4½-inch shields.

The *Challenger* (1899) is the last vessel in this category, policy being now concentrated on the armoured types. This ship is of 12,500 tons and 20·75 knots speed, with a protective deck and an armament of eleven 6-inch guns.

2. Evolution of the Armoured Cruiser.

The descent of the armoured cruiser may, perhaps, be traced from the *Favorite* corvette and the *Enterprise* sloop, wooden vessels commenced in 1860-61, and provided in 1864 with 4½-inch side armour (the same thickness as in the case of contemporary battleships, p. 206), compensation for the additional weight being obtained by reducing the armaments from twenty-two to eleven and from eleven to four guns respectively.

In 1862 the *Research* wooden sloop, with 4½-inch armour and four guns, was laid down.

The *Pallas* iron corvette, of 3,787 tons and six guns, was begun in 1864.

The *Orlando* (1885), of 5,600 tons and 18 knots speed, had 10-inch compound armour on the side, 16-inch on the bulkheads, and 4½-inch protection to the guns, with a 2-inch to 3-inch deck. The armament consisted of two 9·2-inch and ten 6-inch guns.

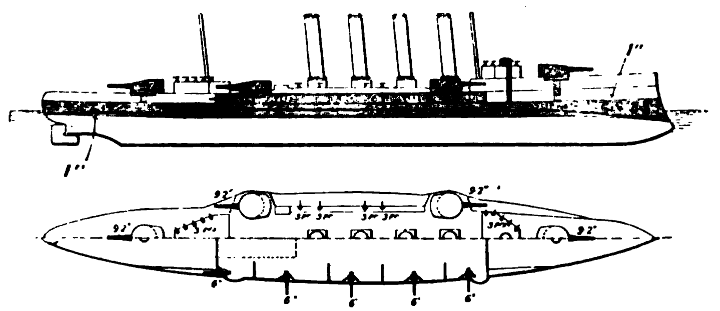
The *Cressy* Class (6), 1898, embodies the features of the *Diadem* and the *Orlando*, on a tonnage of 12,000, with a speed of 21 knots. This class has a 6-inch Krupp steel belt

extending over a little more than half the length and prolonged (3 inches) to the bows. A 2½- to 3-inch deck extends abaft the belt to the stern, and is elsewhere 1½-inch. The armament consists of two 9·2-inch guns, with 6-inch armour, and twelve 6-inch in 6-inch casemates.

The *Drake* Class (4), of 14,000 tons and 23 knots speed, differs from the *Cressys* by having the bows protected by 5 to 3 inches of armour. The 6-inch guns are increased from twelve to sixteen by the addition of four casemates on the upper deck, the armour protection being reduced to 5 inches.

The *Monmouth* Class (10), 1899, is similar, but of 9,800 tons and 23 knots speed. The belt is four inches, 3 inches at the stern; the deck ¾ inch, 2 inches at the stern; and the armament fourteen 6-inch guns behind 5 inches to 4 inches of armour.

The *Devonshire* Class (6), 1902, of 10,700 tons and 22·25 knots speed, is similar, but has a belt increased to 6 inches and an armament of four 7·5-inch and six 6-inch guns.



DUKE OF EDINBURGH

In the *Duke of Edinburgh* Class (6), 1902, of 13,550 tons and 22·5 to 23·5 knots, the belt (6 inches) is prolonged (4 inches) to the bows and 3 inches to the stern. The armament consists of six 9·2-inch and ten 6-inch guns behind 6 inches of side armour, carried up to the level of the upper deck.

15

The *Minotaur* (Class 3), 14,600 tons and 23 knots speed, has the same side protection as the *Duke of Edinburgh*, and an armament of four 9·2-inch and ten 7·5-inch guns, all on the upper deck, the former in double (8 to 7 inches), and the latter in single (8 to 4½ inches) turrets.

3. Evolution of the Cruiser Battleship.

The *Penelope* (1864), of 4,470 tons and 13 knots speed, had 5-inch to 6-inch armour and an armament of eight 9-ton guns. Having regard to her date, this vessel may, perhaps, be regarded as a battleship of small tonnage, or she may possibly have been viewed as an armoured cruiser. The *Penelope* was rarely attached to a sea-going fleet, but was at one time flagship of the reserve. The type was not repeated, and for ten years armour was not applied to cruisers.

The *Nelson* and *Northampton* (1874), of 7,630 tons and 13·5 knots speed, were entitled first-class cruisers, and seem to have been intended to be flagships on foreign stations, where a modified battleship may have appeared desirable. These ships have belts 6 inches to 9 inches over about two-thirds of the length, the protection being continued to the stem and stern by a 2-inch armoured deck below the water-line. The armament consisted of four 18-ton guns protected by 8-inch armour, and eight 12-ton guns unprotected on the main deck.

Some years later (1881) the *Warspite* and *Impérieuse*, of 8,400[1] tons and 16·7 knots speed, were commenced. The belt, 10 inches, extended over less than half the length, and the protection was prolonged forward and aft by a 3-inch armoured deck. The armament consisted of four 18-ton B.L. guns, mounted in single gun turrets (8-inch) on the upper deck, and the side was narrowed fore and aft to permit

[1] These vessels were designed for nearly 1,000 tons less displacement than they proved to possess.

THE EVOLUTION OF CRUISERS.

DATE.	WOODEN FRIGATES AND CORVETTES.	(Cruisers with Armour)	LINE-OF-BATTLE SHIPS.
1860 to 1862.	**Newcastle**, 51 guns		
	Dartmouth, 36 guns	**Favourite**, 11 guns	
	Menai, 22 guns	**Research**, 4 guns	
			(Battle Cruisers)
1864.	**Belvidera**, 39 guns	**Pallas**, 6 guns	**Penelope**, 8 9-ton
1867.	**Briton**, 14 64-prs.		
1871.	**Raleigh**, 24 guns		
1874.	**Diamond**, 12 64-prs.		**Nelson**, 4 18-ton, 8 12-ton
1877.	**Comus**, 6 6", 8 64-prs.		
	Polyphemus of 1879 (sloped armoured deck, 2", 3")		
	(Protected Cruisers)		
1880.	**Arethusa**, 10 6" guns		
1881.	**Mersey**, 2 8", 10 6"		**Warspite**, 4 9·2", 6 6"
		Partial Gun Protection	(*Type ends*)
1885.		**Orlando**, 2 9·2", 10 8"	
	(Gun Protection)		
1888.	**Marathon**, 6 6"		
1888.	**Blake**, 2 9·2", 10 6"		
1889.	**Edgar**, 2 9·2", 10 6"		
1890.	**Latona**, 2 6", 6 4·7"		
1894.	**Powerful**, 2 9·2", 12 6"		
1895.	**Diadem**, 16 6"		
		(Armoured Cruisers)	
1898.	**Highflyer**, 11 6"	**Cressy**, 2 9·2", 12 6"	
1899.		**Drake**, 2 9·2", 16 6"	
1899.	**Challenger**, 11 6"	**Monmouth**, 14 6"	
1902.		**Devonshire**, 4 7·5", 6 6"	
1902.		**Duke of Edinburgh**, 6 9·2", 10 6"	
1905.		**Minotaur**, 4 9·2", 10 7·5"	
1906.			**Invincible**, 8 12"

See Evolution of Battleships.

N.B.—Upright lines denote direct descent; transverse lines indicate the amalgamation of features of two types to produce a new species.

fire on the line of the keel. In addition there were ten 6-inch unprotected guns on the main deck, the forward and after gun on either side being able to fire right ahead or astern respectively. The type then ended, or became absorbed in the smaller battleship, which had become more seaworthy than its predecessors.

The three latest cruisers of the *Invincible* Class, of 17,250 tons and 25 knots speed, begun in 1906, may be said to be a combination of the *Minotaur* and a battleship. Originally entitled armoured cruisers, they were subsequently classed as battleships. The type, which marks a temporary oblivion of the functions of the cruiser, is not likely to be repeated.

The slightest study of the evolution of warships in this country reveals unaccountable fluctuations in design. Types appear and disappear; a promising development is arrested; an intrusive species, such as the *Polyphemus*, asserts itself and perishes. Numerically large armaments shrink to a few heavy guns in the *Devastation;* an auxiliary armament then takes embryonic form, grows steadily till it reaches a maximum in the *Lord Nelson*, and is suddenly abolished in the *Dreadnought*. In the protected cruiser category, also, armaments undergo strange vicissitudes. Speed and tonnage show a generally upward tendency; but the latter is subject to reversions due to economy, to vacillation of opinions, or to some special requirement which assumed temporary importance. The distribution of armour appears to be largely a matter of caprice, and belts elongate and compress with concertina-like facility; while so important a feature as the armoured deck appears and disappears, is sloped or flat, and varies greatly in thickness and position, for reasons which are difficult to ascertain. This may be due to the bewilderment produced by the rapid advance in the efficiency of guns, shell power, and

armour, and also to the infrequency of war experience and to hasty deductions from ill-digested data.[1] It is at least evident that at some periods scientific thinking was either inadequate, or failed to assert itself, and that principles serving to reconcile the conflicting requirements of a ship of war were not formulated.

A well-conceived vessel should continue to be a useful element in a navy as long as her structure remains effective. She may sink in the scale and be forced to accept a lower rôle than that for which she was built; but she will generally be worth maintenance and even rearming. On the other hand, a badly designed ship will quickly become obsolete. The waste of money in the British Navy upon vessels which were never suited for any reasonably probable requirement of war has been enormous, and the necessity for supreme care and unremitting study in directing shipbuilding policy is evident.

FOREIGN WARSHIPS.

The knowledge of the features of warships which is essential to the intelligent direction of the policy and design of coast defences can best be obtained from a study of the British Navy. From the point of view of ability, or inability, to attack batteries on shore, the vessels of foreign Powers do not differ in any material respect. If their evolution has not followed precisely the same lines as in our case, the variations have been in detail rather than in principle. The caution resulting from keen competition among navies has, on the whole, sufficed to prevent the

[1] Thus the action off Lissa led to a widespread belief in the ram, which adequate tactical study would have mitigated, and the cult thus created deeply impressed itself on ship designs. Similarly the torpedo has been retained as part of the equipment of the battleship and large cruiser, although plainly superfluous, a large fleet of special vessels having been provided to suit its special idiosyncrasies.

assertion of any marked individuality,[1] and has maintained a fairly general uniformity of type.

Of all the fleets of Europe, that of Germany shows the most consistent development. The youngest European navy has approached the problems of shipbuilding policy in a scientific spirit, and has, therefore, created a fleet which, in proportion to its numbers, tonnage, and gun power, is extremely efficient.

German armoured cruisers from the date of our *Cressy* Class have continuous 4-inch belts, with protection for the armament. In 1904 the thickness of the belt was increased to 6 inches, tapering to 3 inches. From 1896 to 1899 the main armament consisted of two pairs of 9·4-inch guns at the bow and stern respectively; in later ships the calibre is reduced to 8·2 inches. In the earlier vessels the auxiliary armament consisted of 5·9-inch guns, afterwards increased to 6-inch. The latest designs have 6-inch guns on main deck and 8·2-inch on the upper deck. Except in the *Fürst Bismarck* of 1896, the auxiliary armament is concentrated in the middle portion of the ship on the upper and main decks, the armour being carried up above the latter to form a citadel, and the upper deck guns being placed in turrets.

French armoured cruisers follow the general features of our own; but turrets replace casemates to a great extent. In the earlier ships 7·6-inch guns formed the bow and stern armament and 6·4-inch elsewhere. In the later types the 7·6-inch gun is employed throughout.

Details of the armoured cruisers of foreign naval Powers are given in Appendix J.

[1] The Italian battleships without side armour (*Italia* and *Lepanto*) are instances of a divergence of type, which, however, proved temporary. Similarly, the two-decked turret introduced into the American Navy has not been reproduced elsewhere, and will probably disappear in process of time.

CHAPTER XVI

COMPARISON OF NAVAL FIRE PAST AND PRESENT—DIFFICULTIES IN ENGAGING COAST DEFENCES—EXPERIENCE OF ALEXANDRIA—EFFECT OF SHELLS

On the 29th July, 1794, Nelson, before Calvi, wrote to Lord Hood as regards a request from the General for a ship attack: "I took the liberty of observing that the business of laying wood before walls was much altered of late, and that even if they had no hot shot, which I believe they had, that the quantity of powder and shot which would be fired away on such an attack could be much better directed from a battery on shore."

No naval commander was ever more ready than Nelson to take risks for a sufficient object; but in this letter he showed a perfectly sound instinct. The employment of red-hot shot, which had proved efficacious during the siege of Gibraltar, undoubtedly added to the inherent disadvantages of the ship, and Nelson seems to have clearly realized that, even at this date, the fire of a "battery on shore" was necessarily more accurate than was possible from a floating platform. The views of our greatest seaman have been fully confirmed by all the experience of war, and modern conditions tend to diminish the powers of the ship relatively to the coast battery.

The whole question turns upon the possibility of inflicting permanent damage. Every shell bursting on board ship,

between decks especially, may cause such damage, while projectiles from a battery on a high site, arriving with an angle of descent, may be deflected downwards on impact, and may reach engines, boilers, or magazines. On the other hand, the gun on shore can be permanently disabled only by a direct hit, or by the burst of a large shell in close proximity, while the injury to personnel can be minimized by suitable arrangements.

Here is evidently a wide field for speculation, and different conclusions will be reached by different minds. Experimental naval firing, against targets having any resemblance to well-designed coast batteries, would serve to steady conjecture; but is unfortunately rare, and such war experience as that of Alexandria (1882), where the Egyptian guns were silenced by a large expenditure of ammunition, and with little injury to the ships engaged, lends itself to misconceptions.

There are some essential differences between a naval attack on shore defences now and at the time of the bombardment of Algiers (1816), or that of Acre (1840). Then the vessel enormously outmatched the shore batteries. A line-of-battle ship, with sixty-six guns to her broadside, was superior to any single battery. A fleet was immensely superior to a fortress. Where the coast works were open, the ships could pour in an almost continuous hail of shot. There was room for much wild shooting, and yet there would be plenty of hitting, while the continuity of fire was demoralizing in the extreme.[1] Even

[1] Even thus the ships did not invariably show a marked superiority over coast works unless the ranges were short. Such facts as the following are not without significance at the present day. In July, 1806, Sir Sidney Smith, "with the *Pompée,* an 80-gun ship, the *Hydra,* Captain Munday, and another frigate, anchored about 800 yards from a battery of two guns, situated on the extremity of Cape Licosa, and protected from assault by a tower in which were twenty-five French soldiers." "The line of-battle ship and the frigate fired successive broadsides till their ammunition

in much later days the United States Fleet poured 45,000 shot and shell into Fort Fisher in two successive bombardments, the rate of fire on the first occasion being given as 115 projectiles per minute. It is not surprising that the return fire was ineffective, and soon practically ceased, notwithstanding that the damage caused to the Fort was comparatively trifling.

Again, in the days of wooden ships the ranges were comparatively short.[1] At Algiers, the *Queen Charlotte*, bearing Lord Exmouth's flag, was brought within 50 yards of the mole, and the enemy made the extraordinary blunder of allowing the ships to take up their fighting positions unmolested. At Acre, also, the ships were allowed to take up their assigned stations at 600 to 700 yards from the defences "before a shot was fired from the garrison." The days of short range were advantageous to the ship, because the details of the work attacked could be well made out, the damage being inflicted was seen, and the fire could be directed accordingly. If, therefore, a ship could be laid alongside a shore battery without receiving previous damage, she could crush the latter by sheer superiority of metal and rapidity of fire.

Conditions are completely changed. The relative preponderance of fire which was enjoyed by the wooden ship

was nearly expended, the battery continually replying with slow but destructive effect. The *Pompée*, at which ship alone it directed its fire, had about forty shot in her hull; her mizen topmast carried away; a lieutenant (Slessor), a midshipman, and five men killed, and thirty men wounded. At length, force proving ineffectual, negotiation was resorted to, and after some hours' parley the officer . . . capitulated. It then appeared that the carriage of one of the two guns had failed on the second shot, and the gun had subsequently been fired lying on the sill of the embrasure, so that, in fact, the attack of an 80-gun ship and two frigates had been resisted by a single piece of ordnance."—"Journal of Sieges in Spain," Major-General Sir J. Jones, R.E.

[1] At Copenhagen it was a matter of complaint that the pilots would not accept the responsibility of taking the ships nearer than 400 yards.

is now much less marked, while the guns of the modern coast battery are sufficiently dispersed to make random fire practically useless.

A three-decker of the old type, with forty-eight 32-prs., seventeen 8-inch guns, and one 68-pr. on the broadside, could deliver 2,550 pounds of iron at a single discharge, and in five minutes could fire 330 rounds, weighing in the aggregate 12,780 pounds.

The *Sans Pareil* (1889), with two 110-ton guns, one 10-inch[1] 32-ton gun, and six 6-inch guns on a broadside, could, in the same time, fire about 101 rounds, with a total weight of 16,000 pounds of metal.

The *Majestic* (1895), with four 12-inch and six 6-inch Q.F. guns, could fire about 261 rounds, with a total weight of 48,600 pounds.

Our latest battleship, the *Dreadnought* (1905), with eight 12-inch guns on the broadside, could fire about 60 rounds, weighing 51,000 pounds.

Thus the change from the wooden battleship to the armour-clad has brought about a marked reduction in the number of projectiles fired in a given time, and the minimum has probably been reached in the case of the latest vessel.[2] On the other hand, the weight of metal discharged has greatly increased, being four times as great for the *Dreadnought* as for the three-decker. Smokeless powder affects both attack and defence alike, and all things being taken into consideration, it will probably be admitted that the broadside of the line-of-battle ship, delivered within good

[1] The 10-inch gun is practically unprotected, and the six 6-inch guns are behind only 3-inch armour, and would be quickly put out of action if the ship engaged an efficient coast battery with her broadside.

[2] The absence of any secondary armament in the new *Dreadnought* is a reversion to the type of the *Dreadnought* of 1875. It is probable that history will repeat itself, and that the evolution of the secondary armament in battleships will recommence.

smooth-bore range, was distinctly more formidable to the open batteries of its day than could be that of the *Dreadnought* against modern coast defences. An amateur with a sporting-gun at 40 yards would be a more dangerous antagonist than an average rifle-shot at 400 yards.

At least, it is clear that the importance of individual rounds is now enormously increased,[1] while the possible destructive effect of a single projectile on well-designed works has not been materially augmented. A single lucky 8-inch spherical shell might have dismounted a single shore gun, and killed or wounded all its detachment. A modern 12-inch shell can do no more in a properly constructed battery,[2] while there can be little doubt that a line-of-battle ship, with sixty-six guns to her broadside, engaged at 500 or 600 yards, had a decidedly better chance of obtaining such a hit than a first-class armour-clad of to-day at 3,000 yards. Comparing gun with gun, the accuracy of fire has immensely increased. Comparing ship with ship, the chances of hitting have probably diminished, notwithstanding that naval gunnery has greatly improved.

The ranges at Alexandria were—

Offshore squadron	2,200 to 1,300 yards
Inshore „	1,300 „ 1,100 „
Inflexible and *Téméraire*	4,500 „ 3,500 „

—considerably less than those adopted by the French at Sfax, and both the offshore and inshore squadrons could have attacked at closer quarters. In the exceptional conditions of the case, this might have been an advantage, although the smooth-bore guns, which the Egyptians

[1] Captain (now Admiral of the Fleet Sir John) Fisher, basing his calculations on tonnage, and omitting the 20-prs., arrived at the conclusion that it was necessary to be 620 times as good a shot with the *Inflexible's* guns as with those of a line-of-battle ship.

[2] May effect less, since personnel and the vital parts of the mounting of a modern gun can be well protected against splinters.

handled with comparative skill, might have done more execution. When opposed to well-designed coast works, manned by trained gunners, however, ships are not likely to benefit by adopting short ranges, and unless the shore guns are nearly at the sea-level, their fire will lose in searching effect. The drawbacks of the ship will be the more pronounced as the elevation of the site of the coast battery increases, while in many cases the site can be so fixed as to impose a minimum range upon ships of given draught.

At Sfax, where the guns of the defence were negligible factors, the French boats were placed at "a few hundred yards" from the shore, the gun-vessels at about 2,300 yards, and the armour-clads at 7,000 to 4,300 yards. Such a disposition for the attack of moderately efficient coast defences would have entailed disaster. The boats and gun-vessels would have been speedily sunk, and the armour-clads would have effected nothing. After an extremely deliberate fire of 2,002 projectiles delivered under peace practice conditions, the "defensive power" of Sfax was reported to have been "practically uninjured."

Some facts drawn from the action at Alexandria throw a strong light upon the accuracy of naval fire at this period. Meks Fort, a prehistoric work armed with five heavy R.M.L. guns, nine S.B. guns, and five mortars, packed close together, without any intervening traverses, was engaged by the *Monarch*, *Penelope*, *Invincible*, and *Téméraire* for about three and a half hours. During one hour the *Inflexible* contributed a portion of her fire. The ranges of the three first-named ships varied from about 1,300 to 1,100 yards; that of the *Téméraire* was 3,500, and of the *Inflexible* 3,800 yards. The *Invincible* and *Téméraire* were anchored throughout the affair. The guns of Meks Fort were practically all *en barbette*, the two heaviest of them (10-inch and 9-inch

R.M.L.) firing over a parapet 4 feet 8 inches high.[1] During the action not a single gun was dismounted or disabled, and two only were touched by heavy projectiles, which just grazed them, leaving indents 1¼ inches deep. One gun was dismounted by an 8-inch Palliser shell from the *Penelope*, fired at short range after the work was silenced, when, therefore, there was no return fire, and no smoke enveloping the battery. The two grazes may, of course, have been similarly obtained. Altogether about 580 heavy and 340 light projectiles were fired at Meks Fort. Theoretically this work should have been silenced in ten minutes by the machine guns of the inshore squadron alone. That Meks Fort was able to reply for more than three hours to the overwhelming fire poured into it clearly shows that low-level *barbette* batteries, if properly built, can be fought effectively. If this particular work had been constructed in accordance with the most elementary principles of defence; if the Egyptian gunners had been able to handle the rifled guns as well as they did the smooth-bores;[2] and if the armament had been supplemented by a few quick-firing guns on the flanks and in Fort Namusia above, the ships would have been driven off without any difficulty.

Again, the *Inflexible*, at about 3,500 yards, partly at anchor and partly under-weigh, engaged two "most troublesome" 8-inch guns in Fort Oom-Kabebé for about four and a half hours. She was simultaneously engaged with Fort Ras-el-Tin. The two Egyptian guns fired over 4 feet 3 inch sills in a straight parapet 5 feet 6 inches high, and were 36 feet apart without any intervening traverse. The whole sea-front parapet of the work was hit nine times, the

[1] The parapet was not finished, and the interior wall projected nearly 2 feet above the existing level of the sand protection, thus making the conditions as unfavourable as could be conceived.

[2] The *Invincible* was hulled fifteen times, and the *Penelope* eight, in addition to receiving a round shot in one of her ports.

top of the counterscarp or glacis three times. The extreme hits were 120 yards apart. The face containing the two 8-inch R.M.L. guns was hit four times, three hits occurring on the superior slope and one on the cordon of the scarp. The three hits on the superior slope made large craters, the shells bursting well. One of them blew in the revetment wall between the guns for a length of 12 feet and a height of 3 feet. Neither gun was touched except by masonry splinters. If these guns had been 9-inch or 10-inch R.M.L., manned by European gunners, the *Inflexible* would have suffered most severely, and her return voyage to port might have been extremely precarious.

In many respects the action at Alexandria supplied a wholesome corrective to views based mainly on too wide a generalization from unsuitable data. Far too much accuracy is generally expected from the fire of ships of war, and the standard attained at Alexandria was quite as high as there was any reason to anticipate. Had the action been postponed one day, or had the ships been seriously injured, as must have happened if the Egyptians had understood how to use their rifled guns, there would have been a marked falling off in accuracy. Had the designs of the Egyptian works been moderately satisfactory, the results obtained would have been trivial.

The Alexandria affair teaches another lesson, extremely important to the defence. It is useless for ships to engage coast batteries by circling in front of them. They must either anchor or steam up to a buoy to fire, and the elliptic courses, which theory has delighted in prescribing, must be given up where coast defences cease to offer an easy and conspicuous target. The circling movement at 1,700 to 2,300 yards with which the action was begun by the *Alexandra, Sultan*, and *Superb* was copied by Admiral Sampson's

squadron off San Juan, Porto Rico, with no better results (p. 178).

Admiral Porter's orders before the attack on Fort Fisher laid down that " all firing against earthworks when the shell bursts in the air is thrown away. . . ." " A shell now and then exploding over a gun *en barbette* may have a good effect, but there is nothing like lodging a shell before it explodes." A shell burst directly over a gun would doubtless be effective, but it would be interesting to know how many a ship would have to fire before obtaining such a result.

In the whole action at Alexandria, in spite of the many advantages on the side of the ships, the total number of hits on the parapets of all the works—*i.e.*, on the superior and exterior slopes—was about one in nineteen rounds, excluding shrapnel and segment. A large proportion of these hits were on exterior slopes, and were thrown away, while the average was certainly improved by some short-range practice after the works were silenced.

Tables of penetration into earth and sand have found their way into various text-books with no words of qualification. It is hardly too much to assert that they are totally misleading. Whatever may be the penetration attained in specially constructed butts, or arrived at by calculation open to objection, it is sufficiently established that parapets of earth or sand with exterior slopes will not hold projectiles so as to enable them to penetrate properly. At Alexandria the penetrations, judged from a large number of examples, were extremely small. The shells turned up at once, and either ricochetted high over the works, or were stopped, and lay on the superior slope, base to the front. A 16-inch shell from the *Inflexible*, fired at under 2,000 yards range, was thus stopped after penetrating less than 20 feet of sand. As might be expected, this tendency to be immediately deflected is still more marked in the case of B.L.

guns with high velocities. At Eastbourne, an 8-inch B.L. Palliser shell fired at 1,193 yards gave a penetration of only 6 feet into a loam parapet with an exterior slope of one in two. At Lydd, the effect of three 9·2-inch B.L. Palliser shells, fired at 1,200 yards against a similar parapet, was almost *nil.*

It may be laid down, therefore, as an axiom that the fire of a ship is quite unable to breach or to damage seriously a properly constructed parapet, that exaggerated estimates of penetration must be modified, and that in works exposed only to naval fire nothing is gained beyond a certain point by adding earth protection. Further, the Eastbourne experiments, as well as the effects obtained at Alexandria, prove that shells bursting on a superior slope, and causing craters which do not extend to the crest, effect no damage in the interior of an emplacement.

Shrapnel was at one time, to some minds, a species of bugbear. The real effect of the 417 shrapnel and segment shell fired at Alexandria is difficult to estimate. One gun and carriage received forty-nine shrapnel bullet hits, all apparently inflicted by a single 11-inch shell from the *Téméraire,* the head and base of which were picked up in front. This gun peered through an embrasure, the neck of which had been previously ruined by the fire of the *Inflexible.* Moreover, it is probable that the shell was fired the day after the action. The remaining shrapnel hits on guns and carriages might have been counted on the fingers, but it is possible that very oblique grazes might not have left a distinguishable mark.

Some of the naval officers engaged at Alexandria were impressed by the good results of the shrapnel fire; but these results—if any—must have been largely due to the defects of the Egyptian works. In estimating the effects obtained at Alexandria, it is necessary to separate those which the shortcomings of the shore batteries rendered

inevitable. In Meks Fort—a work almost *à fleur d'eau* —there was hardly a place where the head of a man of average height would have been covered even if he stood close to the parapet.

The Inchkeith experiments, carried out in August, 1884, throw a certain light on the performance of shrapnel at Alexandria. In all, thirty rounds were fired from the 10-inch R.M.L. guns of the *Sultan* at ranges varying from 850 to 3,500 yards, the average being about 2,330 yards. The conditions so far as the ship was concerned were ideal. The sea was calm; the ranges could be obtained with great nicety; the firing was by single rounds, and excessively deliberate; undivided attention could be given to each round; there were no elements of disturbance; the Inchkeith gun presented an excellent target. On the first day, out of fifteen rounds fired with battering charges, one ball found its way into the emplacement. On the next day, full charges were used, and two good bursts were obtained in fifteen rounds. Four dummies were hit; six balls struck the gun, six balls and three splinters the carriage and platform. In addition, one of the elevating wheels was broken, and the traversing gear placed at the rear of the platform was disabled by splinters. The target gun could still have been worked without any difficulty. All idea of attacking modern coast defences by shrapnel fire may now be abandoned.

At Alexandria, the fleet carried about seventy 1-inch 4-barrel Nordenfeldts, and expended more than 16,000 bullets. The expenditure of Gatling ammunition was only 7,000 rounds, and of Martini bullets 10,000.

As to the results obtained, opinions have differed. The number of hits on the Egyptian guns and mountings must, however, be taken as affording some indication of those results. The hit of a Nordenfeldt bullet on iron is generally unmistakable, but it is evidently possible that grazes at

16

acute angles might have escaped observation. The total number of hits on guns and carriages was seven, and even this moderate number requires qualification. One hit was on the liberal target offered by the bracket of a 9-inch Moncrieff carriage. This carriage stood naked upon the shore, the formality of building up protection round it having been omitted. The gun was, of course, never fired, and the natural fondness of the sailor for a good upstanding target can alone account for its being fired at.[1]

The high exposed scarps of Forts Ras-el-Tin, Adda, and Pharos, distinctly showed every Nordenfeldt hit, but the total number of such hits was insignificant. It is stated that at the Ingogo action, where the Artillery suffered severely from rifle fire, the guns were actually whitened by bullet splashes. A fair inference seems to be that, at Alexandria, the vast majority of the 16,000 bullets fell short ; or, as was actually the case at Meks, flew well over the battery.

Captain (now Admiral of the Fleet Sir John) Fisher states : "Most of our ships used their Nordenfeldt machine guns, but nothing is known as to the effect produced. The bullets were found far and near, so it is to be feared the fire was not very accurate. It is difficult—indeed, almost impossible—to see where the comparatively small Nordenfeldt bullet hits." The conditions at Alexandria were favourable to machine guns. The ranges of the inshore squadron were moderate, and the tops of the ships were above the level of the guns in Meks Fort,[2] which was so designed as to give every advantage to the attack.

[1] At least four heavy projectiles were also fired broadside on at this carriage, which received one splinter-hit only.

[2] Of all the works at Alexandria mounting rifled guns, Meks was the worst. The Egyptians intended to remodel it entirely, and the proposed design was picked up by the writer in a casemate near. Had the changes been carried out, the difficulty of silencing the work would have been greatly increased.

Great possibilities were formerly claimed for these guns, one authority having pointed out that "it might be quite possible for a boat armed with a machine gun to keep a heavy gun silent—that is, if the boat could manage to begin."[1] It is not easy, however, to see why a boat firing at the water-level should succeed, when the machine guns in the tops of the *Penelope* and *Invincible* failed during three and a half hours; and this opinion can only be regarded as the outcome of speculation uncorrected by experience, and unsupported by ballistic laws.

The explanation of the failure of the machine guns at Alexandria is, doubtless, that the average range was too great for accurate practice under service conditions, and that, even at the shorter ranges, the smoke of the guns of the attack and defence, together with the sand thrown up and smoke caused by the bursting shells, completely obscured the fall of the bullets, so that no proper direction of fire was possible.

The Inchkeith experiments, under the conditions stated on p. 241, when the fire was concentrated on a single remarkably conspicuous shore-gun, form an interesting comparison with the Alexandria results. The total number of machine-gun rounds fired was 15,210, by which 15 dummies were hit. In the first four series 1,541 rounds were fired, with the result of hitting one dummy. In another series 4 Gardners and 2 Gatlings on deck fired 2,815 rounds, obtaining three hits on dummies. In a third series, 13 machine guns fired 3,874 rounds, hitting two dummies. This was target practice, and the dummies remained fixed in the most exposed positions which the loading numbers could occupy.[2] The failure of the machine-gun fire at Alexandria

[1] R.E. Occasional Papers, vol. vii.

[2] Nos. 2 and 3 stood always *on* the loading-stage, about half their bodies being fully exposed. No. 5, who was supposed to serve the muzzle derrick

was therefore quite natural. During an Artillery engagement between ships and coast defences, machine guns cannot play any effective rôle on either side.

On the other hand, for the self-defence of the coast battery against the attack of a landing-party, such a machine gun as the Maxim is well suited.

The smaller quick-firing guns, 3-pr., 6-pr., 12-pr., would be practically useless against guns mounted as shown in Plate XXVII., unless hits on the chase or on the face of the muzzle could be obtained. The size of the target presented by the exposed chase of a 9·2-inch gun (Plate XXVII.) broadside on is about 36 square feet, and oblique hits would do no damage. The chances of obtaining any effective results from the fire of these small quick-firing guns on board ship is, therefore, infinitesimal, and in engaging modern coast defences they could play no useful part.

A little reasoning will serve to show how great are the difficulties of naval attack on properly designed coast batteries, and will explain the causes of failure. Naval gunnery has attained a standard of proficiency never previously approached, and further advances will doubtless be made; but the accuracy of fire of guns on shore has increased in a greater degree, and the inherent inequality of the contest will remain.

Practically the only way in which the ship can hope to effect permanent injury on shore armaments is (1) by obtaining direct hits on guns or their mountings, or (2) by bursting heavy shell exactly on the crests of emplacements.

The areas of the service targets used for naval prize-firing are—

—a duty he could have performed with a boathook from the loading-way in perfect security—stood on the platform girder, and was exposed down to his knees.

BATTLE PRACTICE.

Battleships and cruisers .. .. 2,700 square feet.
Ranges about 7,000 yards.

GUNLAYER'S TEST.

Heavy guns .. .. 350 square feet.
Ranges about 1,400 to 1,650 yards.

On the other hand, the areas of the targets offered to a direct hit in the case of the guns and mountings shown in Plates XXVII. and XXVIII. are—

	9 2 in. (Pl. XXVII.).	6-in. Q.F. (Pl. XXVIII.).
Broadside	115 ..	38 square feet.
End on	49 ..	18 ,,

These figures tell their tale, especially if it is remembered that the shore-gun can usually be rendered a difficult object to aim at as compared with the naval target. Even if, therefore, all the disturbing influences arising in action are left out of account, the difficulty of obtaining direct hits, from the point of view of target practice only, must be extreme.

Again, it is clear that the burst even of a large shell at a comparatively short distance in front of the crest of a gun emplacement will inflict no serious damage. It follows that the horizontal area of the dangerous target in the case of the emplacements shown in Plates XXX. and XXXI. is—

For the 9·2-inch gun about .. .. .. 170 square feet.
,, 6-inch ,, ,, ... 72 ,,

At Alexandria, out of 1,620 rounds fired (7-inch and upwards), only eleven hits at and near the crests[1] of the Egyptian batteries were obtained; but as many of them

[1] By "near the crest" is meant near enough to blow it in upon the emplacement.

did not occur in front or nearly in front of a gun, they would in a traversed battery have been quite ineffective.

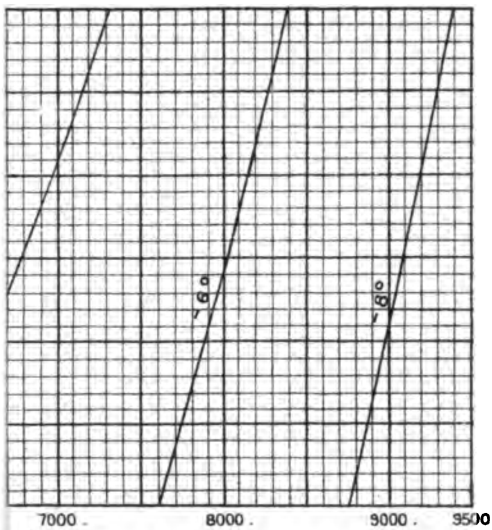
Further, unless the shell from the ship arrives with a descending angle, the chances of effect are minimized, and it is in searching power that modern naval fire is essentially and increasingly weak. To fix the ideas, the range-table of the 9·2-inch B.L. gun, Mark XI., may be taken, and it will be found that at 2,500 yards range the trajectory will be horizontal at the crest of a battery at a height of about 140 feet (see Diagram 1). At all less ranges the trajectory will be rising. If the crest were at the sea-level, the ranges giving a falling trajectory of 3 degrees, or about 1 in 14, would be over 5,000 yards. If the height of the crest were 200 feet, the ranges necessary to secure a falling trajectory of 3 degrees would be about 5,800 yards.

The searching power of the fire of modern ships is, therefore, strictly limited, and the difficulty of killing men or damaging material behind a high parapet has been insufficiently appreciated; while the danger to the crest of a modern gun emplacement cannot be regarded as serious.[1] As regards searching effect, ships are now in a worse position than they were fifty years ago, and as muzzle velocities increase their power will, in this respect, be further diminished.[2]

[1] General (the late Field-Marshal) Sir L. Simmons stated in 1870: "What is the chance of a shot fired from an unstable platform, like the deck of a ship, striking a battery at 1,600 or 1,800 yards, so near the crest as to do any injury to it? I believe myself it would be absolutely throwing away ammunition to attempt it" (R.E. Corps Papers, vol. xviii.). The high-velocity guns subsequently introduced, in spite of their greater accuracy, have certainly not increased the chances of such a hit.

[2] In view of this difficulty it was at one time suggested that a partial or complete reversion to short guns and low velocities might be expected, thus illustrating the false idea that engaging coast defences was the legitimate business of the ship-of-war. Obviously the latter must be armed solely to enable them to fight other ships, and the principal object has, therefore, been to increase velocities. The 10-inch R.M.L. gun of 1865

H GUN MARK XI.
E M.V. 2899 F.S.



the

e 9·2-inch gun will arrive at
ıge.
it is falling.)

ıip, to determine the angle at

angle of descent will be a little
2°.

ectile will arrive with a given

nly be obtained at a range of

est must be in order that the

re horizontal, the height must

Better searching effect could be obtained by using reduced charges, but this complicates matters and entails inferior accuracy.

In August, 1886, some interesting experiments in high-angle fire were carried out from an 8-inch 70-cwt. howitzer mounted on board H.M.S. *Hercules* off Shoeburyness; but although the ship was anchored in smooth water, it was found impossible to place a shell within 20 yards of a conspicuous target flag at only 1,500 yards, while two rounds fired with the same elevation and charge on the same day gave a difference in range of 370 yards. This howitzer on shore was capable of making excellent practice at 2,400 yards, and the difficulty of using it on board ship, where the clinometer cannot be employed, was well illustrated

It is most improbable that special warships will again be employed for high-angle fire. Modern Artillery has rendered superfluous the rôle of the bomb ketch, or the mortar boat, which was last used in the American Civil War. Present naval tendencies are in the direction of building fleets for the purposes of opposing other fleets, and the armoured gunboat and "coast defence armour-clad," upon which we have wasted large sums, have happily fallen into disfavour.

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had a muzzle velocity of 1,374 feet per second; while that of the latest 9·2 inch B.L. gun has a muzzle velocity of about 2,900 feet per second, and the increase is still going on.

CHAPTER XVII

COAST BATTERIES — ARMAMENTS — SELECTION OF SITES— GENERAL REQUIREMENTS OF DESIGN

THE advantages which well-designed coast defences possess over ships may be summed up as—

(*a*) Relative immunity from injury, due to the very small vulnerable target offered, and also to invisibility. This has been proved by ample war experience.

(*b*) Greatly superior accuracy of fire. This results indirectly from (*a*), and also from the far more favourable shooting conditions and the excellent range-finding appliances available on shore.

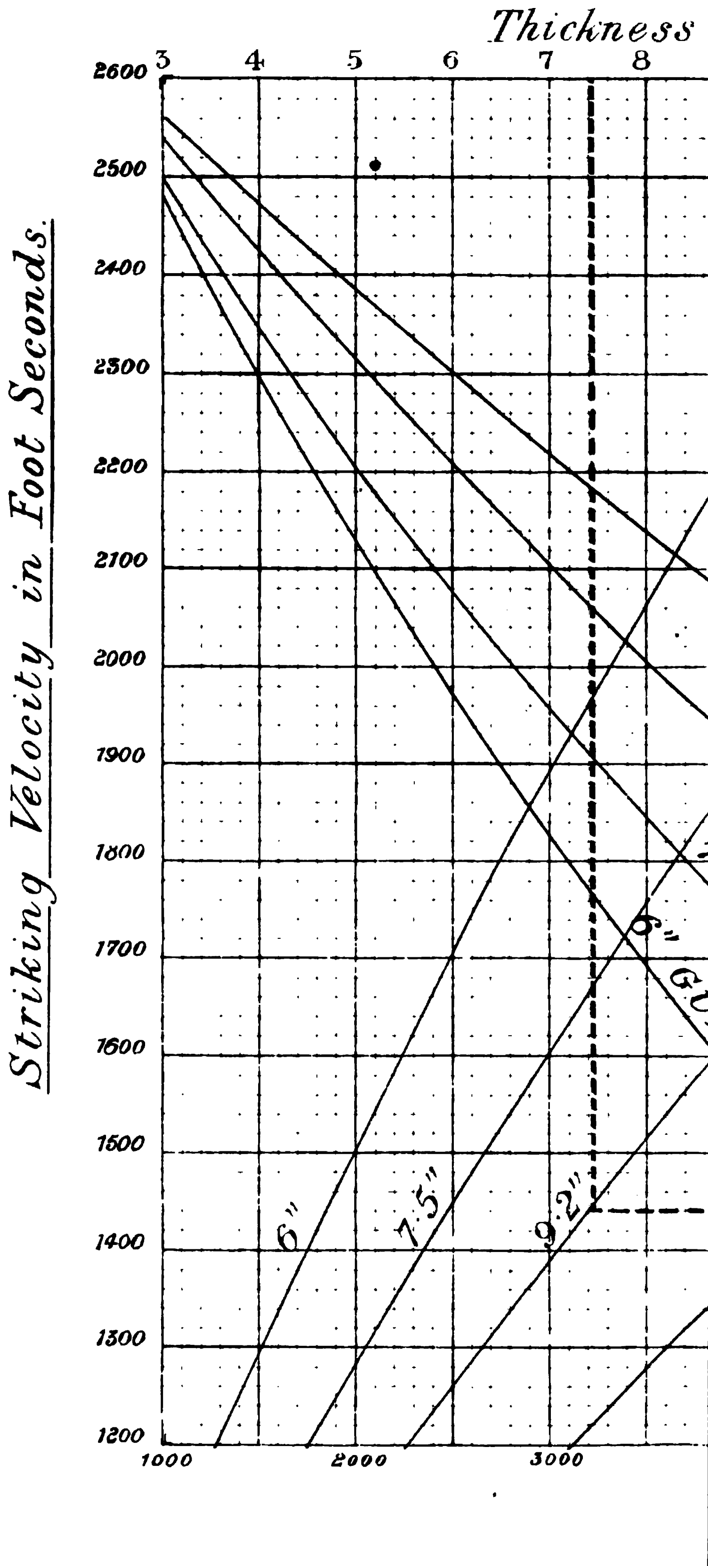
(*c*) The power of delivering a plunging fire when the guns are mounted at a height above the sea-level. Projectiles striking the deck of a ship at a descending angle may, if deflected downwards, reach engines or magazines.

(*d*) An abundant supply of ammunition.

As pointed out (p. 183), the probability that British coast defences would be attacked by an enemy's battleships is necessarily remote. Even in this case, however, there is no justification for an armament heavier than the 9·2-inch gun.

The following table serves to give an idea of the comparative penetrative power of various guns, assuming uncapped projectiles and impact at right angles :

RANGE AND PE


Thickness
3
4
5
6
7
8
Striking Velocity in Foot Seconds.
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1000
2000
3000
6"
7·5"
9·2"
6" GU

Gun.	Muzzle Velocity.	Weight of Projectile.	Penetration Krupp Armour at 3,000 Yards.
	F.s.	*Lb.*	*Inches.*
12-inch Mark X.	2,900	850	17·0
10-inch Mark IV.	2,040	500	7·5
9·2-inch Mark XI.	2,879	380	10·5
7·5-inch	2,800	200	7·75
6-inch Mark XI.	2,933	100	5·0

Diagram 2, prepared by Mr. R. A. Hadfield, provides a most convenient method of ascertaining the penetration of certain guns, assuming impact at right angles. This diagram can be used, as indicated by the green and black dotted lines, to determine either the range at which any assigned penetration can be obtained by a particular gun, or the penetration which is possible at any assigned range.

The power to penetrate thick armour is not, however, a primary consideration. The main object of coast defence guns is to inflict the maximum number of damaging hits in the shortest time. Recent experiments have shown that common shell is capable of penetrating, with the most destructive results, armour believed to be capable of resisting it. This unexpected phenomenon appears to be due to the high velocities now attained, which enable a thin-walled shell to penetrate before the time required to break it up has elapsed.[1] It is probable, therefore, that coast Artillery will require two classes of projectile only—a common shell of large capacity and an armour-piercing shell with a burster as large as is compatible with adequate strength. It is not clear that any real advantage is gained by employing a high explosive. The large fragments into which a shell is broken by a powder burster are capable of spreading destruc-

[1] Just as the tallow candle can be fired through the barn door.

tion on board ship, and of breaking through a thin-armoured deck. The violent effect of high explosives is local only, and there have been difficulties in ensuring complete detonation. On the other hand, the use of powder-bursting charges greatly increases the amount of smoke, tending to obscure the target.

In any case, the modern warship presents a large target, of which only a portion can carry thick armour. The experience of the battle of Tsushima plainly shows that the penetration of thick armour is not essential, and that frequent hitting by the shells of guns of medium calibre may be decisive. It is evident that the Russian battleships engaged at Tsushima would have been easily repulsed by coast defences mounting 9·2-inch and 6-inch guns. Far less punishment than these ships actually received would have amply sufficed for the purpose.

The protection afforded by a belt is a maximum only when the ship is at a certain trim which cannot always be maintained. Thus, at the battle of Tsushima, owing to the large quantity of coal on board, some of the belts of the Russian ships were too deeply immersed. In any case, a ship of great beam, if light in the water, will expose her below-belt area if rolling through a small angle.

At fighting ranges, the theoretical accuracy of the 9·2-inch gun (Appendix G.) scarcely differs from that of the 12-inch; while in actual practice at sea, up to nearly 7,000 yards range, the 6-inch gun (Appendix H.) can be counted upon to give a much greater number of hits in a given time than either. The destruction of funnels proved to be disastrous in the case of the *Suvoroff* at Tsushima, and a gun which, by reason of its high speed of fire, offers the best chance of inflicting this injury and also of wrecking control stations and superstructures is necessarily valuable. For reasons

which are not clear[1] the accuracy of fire of a 12-inch gun on board ship does not correspond to its ballistic capabilities, and its performance in action has been somewhat disappointing. Thus, off Santiago, out of eighty-six rounds (13-inch and 12-inch) fired, only two hits were obtained, although the Spanish ships offered large targets, and the ranges were generally moderate. The evident failure of the forty-five heavy Russian guns (twenty-six 12-inch, fifteen 10-inch, four 9-inch) may have been mainly due to inefficient handling; but the few heavy Japanese guns (sixteen 12-inch and one 10-inch) were quite unable to cause the sustained hail of shells which brought about the catastrophe, and some of the 12-inch guns seem to have been so much worn by previous firing as to have lost accuracy.

In a coast battery, however, the 9·2-inch gun should shoot well up to range-table standard (see Appendix G.); while the 6-inch gun with an auto-sight will far surpass in speed and accuracy of fire the possibilities on board ship. The latest war experience plainly shows that frequency of hitting is now, as always, supremely important, and it is from this point of view that the 6-inch gun, which is doubtless capable of further development, must be regarded as well suited for coast defence. The great advantage of speed of fire is due to the fact that the projectile of the 6-inch gun can be easily handled.[2] This at present fixes the limit of size; but if in the future mechanical arrangements, fulfilling service requirements, can be devised which will confer equal speed of fire upon a heavier gun, such as the 7·5-inch, its adoption for coast defence would be justified in some cases.

[1] It is possible that the advantage arises from the fact that the smaller gun instantly responds to the gear in the layer's hands, while in the case of the heavy gun there is an appreciable delay.

[2] The introduction of smokeless powder has evidently increased the advantage of the rapid firing gun, which can now approach its maximum rate of fire in action.

The most recent theory, that naval actions will in future be fought at a range of about 10,000 yards, and that the ideal warship should possess speed to enable her to maintain this distance,[1] is opposed to reason and to experience. The navy which adopts tactics based on this theory will court failure and moral deterioration. If, however, coast defences are to be engaged with the smallest hope of success, ranges not exceeding about 3,500 yards must be adopted. At longer distances the chances of inflicting effective hits upon targets so minute as those presented by coast Artillery in well-designed emplacements are, and will remain, infinitesimal. At practical fighting ranges, therefore, the 6-inch guns mounted on shore (see Appendix H.) will possess a considerable margin of hitting power.

Some foreign Powers have adopted howitzers or mortars on a considerable scale in their coast defences. Thus, the Russians had mounted ten 11-inch and twenty-two 9-inch howitzers in the coast forts at Port Arthur, or thirty-two howitzers to forty-one guns, 6-inch and upwards.[2] Similarly, the Americans, who have been led to exaggerate the requirements of fixed defences (p. 169), employ many mortars in their coast batteries. The experience gained at Port Arthur was not altogether encouraging as regards the use of high-angle fire. The Russian vessels in the harbour —four battleships and two cruisers[3]—were sunk by opening their sea-valves as soon as the Japanese had captured 203 Metre Hill (see Map). Fire was subsequently directed upon them from 11-inch howitzers at ranges up to about

[1] Practical experiments to test the proof of this part of the theory are unfortunately wanting, and the tactical advantages of a moderate superiority of speed in a fleet action have not been demonstrated.

[2] See footnote, p. 176.

[3] Battleships *Retvisan*, *Peresviet*, *Pobeida*, *Poltava*; armoured cruiser *Bayan*; protected cruiser *Pallada*.

7,500 yards.[1] This was deliberate practice from siege batteries at stationary targets; but the effect was distinctly disappointing. Having regard to the superior accuracy of direct fire and to the fact—rendered manifest at the battle of Tsushima—that battleships of recent construction can be disabled, and even sunk, by such fire, the provision of howitzers for coast defence seems to be unnecessary.

The standard of reasonably probable attack having been laid down by the Admiralty, and the nature of the armament to be employed having been decided, it becomes possible to frame a scheme of defence fulfilling the requirements of a given locality. As the ruling conditions, hydrographic and topographic, differ widely, each case must be studied on its own merits. Principles only can be formulated, and their application to individual ports must be left to naval and military experts.

The first step is to settle definitely, with the aid of a chart, the water areas which it is essential to deny to an enemy's vessels. This is mainly a naval question, and the landsman will usually make light of difficulties of navigation, however great. On the other hand, the naval officer, imbued with a natural belief in the universal efficacy of the warship, will frequently advance claims exceeding practical possibilities. All experience shows that, unless a definite and considerable object can be attained, ships will not be subjected to the fire of efficient coast defences. The deterrent influence exercised by the latter will evidently be greatest in waters far distant from a friendly base,[2] and must

[1] In addition some 6-inch and 4·7-inch guns fired on the ships at shorter ranges.

[2] In the Franco-Chinese War of 1884, *La Galissonière* made at once for Hong-Kong, in consequence of a single hit received in a brief engagement with the Min forts.

operate with peculiar force in the case of the inferior of two belligerent navies.

The waters that coast defences are required to deny to an enemy's warships are either (1) those which lead into a sheltered harbour, or (2) those from which effective fire, capable of inflicting damage on national resources, such as dockyards, arsenals, and valuable shipping, can be directed. If a channel is long, narrow, tortuous, and tidal, large warships clearly will not attempt to enter it. If it is short, easy, and navigable at all times ; if, further, it leads into waters where there is a free manœuvring area, access to which would give an enemy's vessels the power of inflicting serious damage ; and if, finally, there is no prospect of being caught by a superior naval force, an attempt to enter might be made. In such a case, coast batteries commanding the approaches may not suffice, and guns bearing on the interior waters may be needed. It is possible, however, that submarine boats may prove capable of fulfilling this requirement (p. 272).

Coast batteries, unless about 4,000 yards in advance of the national resources to be protected, cannot be trusted to prevent a long-range bombardment by ships in motion. Whether such a bombardment would be undertaken depends entirely upon the measure of the probability of obtaining results commensurate with the expenditure of ammunition. The fire of a ship, directed on a magnetic bearing against an invisible target of small area at ranges exceeding 10,000 yards, cannot be effective. On the other hand, a town would undoubtedly suffer to some extent, though less than is generally believed, and the successive naval bombardments of Port Arthur by the Japanese (p. 179) seem to have been practically useless. The infliction of injury upon civil buildings in circumstances which excluded reasonable probability of any military result may be

technically in accord with the customs of war.[1] It would, however, justify reprisals in kind, which the superior naval Power could at once carry into effect.

All questions of this nature having been studied exhaustively, the water area to be denied to an enemy's ships can be determined, and the natural features of the adjacent coast-line must then be taken into consideration. The reverse process has sometimes been followed, an attractive site having been selected for a battery the functions of which are not apparent. In choosing the gun positions, the following conditions, in order of importance, should be fulfilled as far as possible :

(*a*) The field of fire should be unrestricted, to allow the gun the maximum scope for its powers.

(*b*) The site should be such as to adapt itself to the construction of emplacements, both as regards protection and invisibility. Height confers distinct advantages.

(*c*) Convenience of command and of the general supervision of fire should be secured.

Thus a compromise will usually be inevitable, and will be satisfactory in proportion to the consideration shown to fighting efficiency.

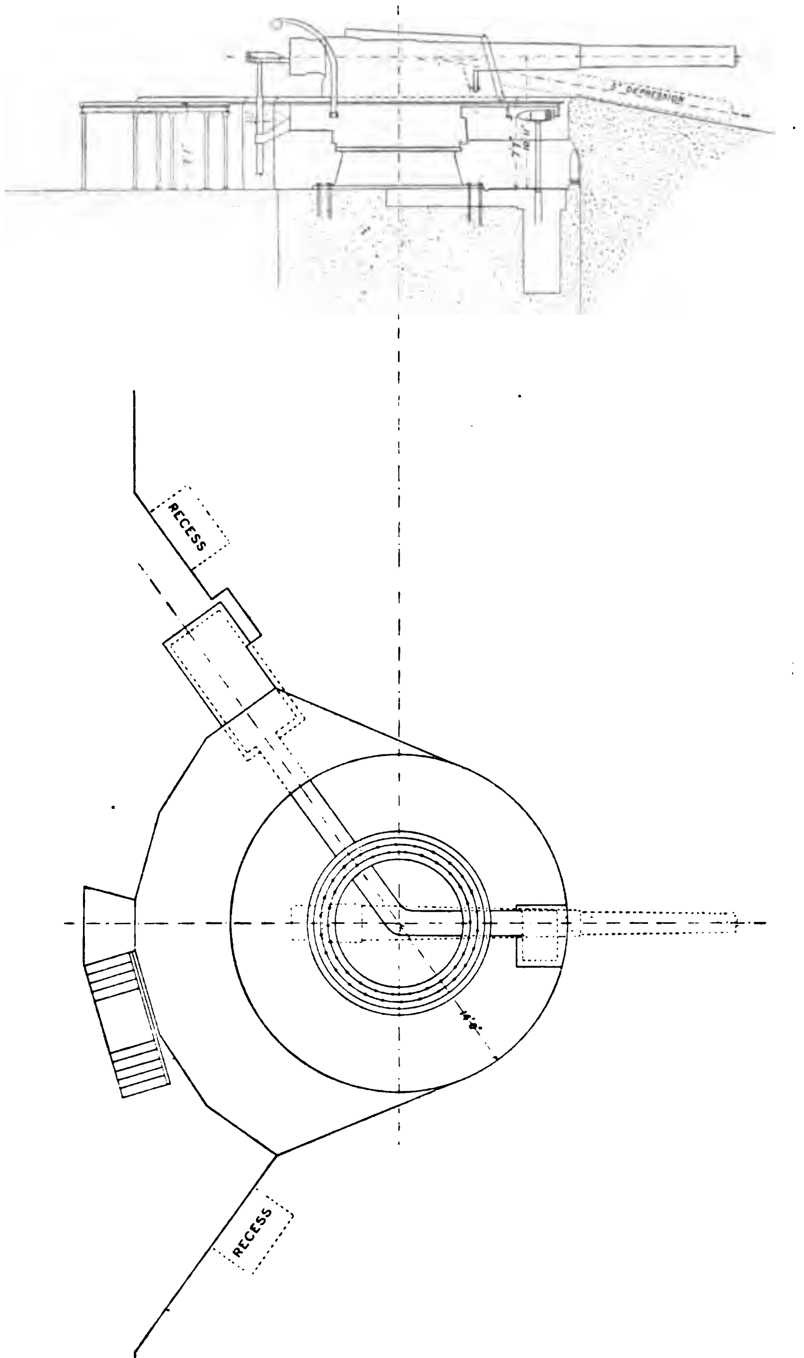
In order to comply with condition (*a*), dispersion will be necessary, and in some cases sacrifice of range may be justified, with a view to gain the marked advantages of high sites. If any portion of the water area to be protected involves difficulties of navigation, it should be sought to bring a concentration of fire to bear upon such portion, and in all cases to permit guns to support each other, while avoiding mutual interference of fire.

[1] In the case of isolated ports, for example, it might be claimed that the bombardment of a town was justified as a possible means of extorting surrender from the local authority. Such a plea could hardly be raised, however, in the case of a home port under the direct control of the central Government.

To fulfil condition (*b*), it is essential to study the natural features of the position on the ground itself, and also, most especially, from the sea. Plates XXX. and XXXI. show typical emplacements for the 9·2-inch and the 6-inch gun respectively, and it is evident that such small structures can generally be blended into the landscape presented by the coast-line without difficulty. Steep ground in rear of a gun should always be avoided. Standing out against the sky-line, a gun will usually be a more conspicuous object than if provided with a background; but, on the other hand, errors of excess in elevation cannot be corrected by observation. The best background is a natural slope at a distance of not less than about 200 yards in rear of a gun; but trees are valuable in promoting invisibility. The foreground should be disturbed as little as possible, and the planting of indigenous shrubs will sometimes be advantageous. Concrete, when it can be seen from the sea, should always be coloured, and various ways of rendering guns invisible—painting, bushing, and the avoidance of clean-cut slopes and well-trimmed turf—are open to the engineer who will study a position, at various ranges and in various lights, from the point of view of the ship, instead of contenting himself with the inspiration of the drawing office.[1] Diagram 3 serves to illustrate the advantages of height, which are enhanced by the accuracy of range-finding at the longer ranges.

For purposes of command in action (*c*) it is desirable to mount guns in pairs of similar natures, forming a group. The symmetrical battery, with two heavy guns in the centre and one smaller gun on each flank, should, therefore, be rigorously excluded from defence projects. The guns of

[1] See "Invisibility," by the writer, R. E. Corps Papers, vol. xi., 1885. Attempts in this direction have since been made in the case of our coast works, with marked success in some instances.



TYPICAL EMPLACEMENT FOR 9·2-INCH GUN ON MARK V. MOUNTING.

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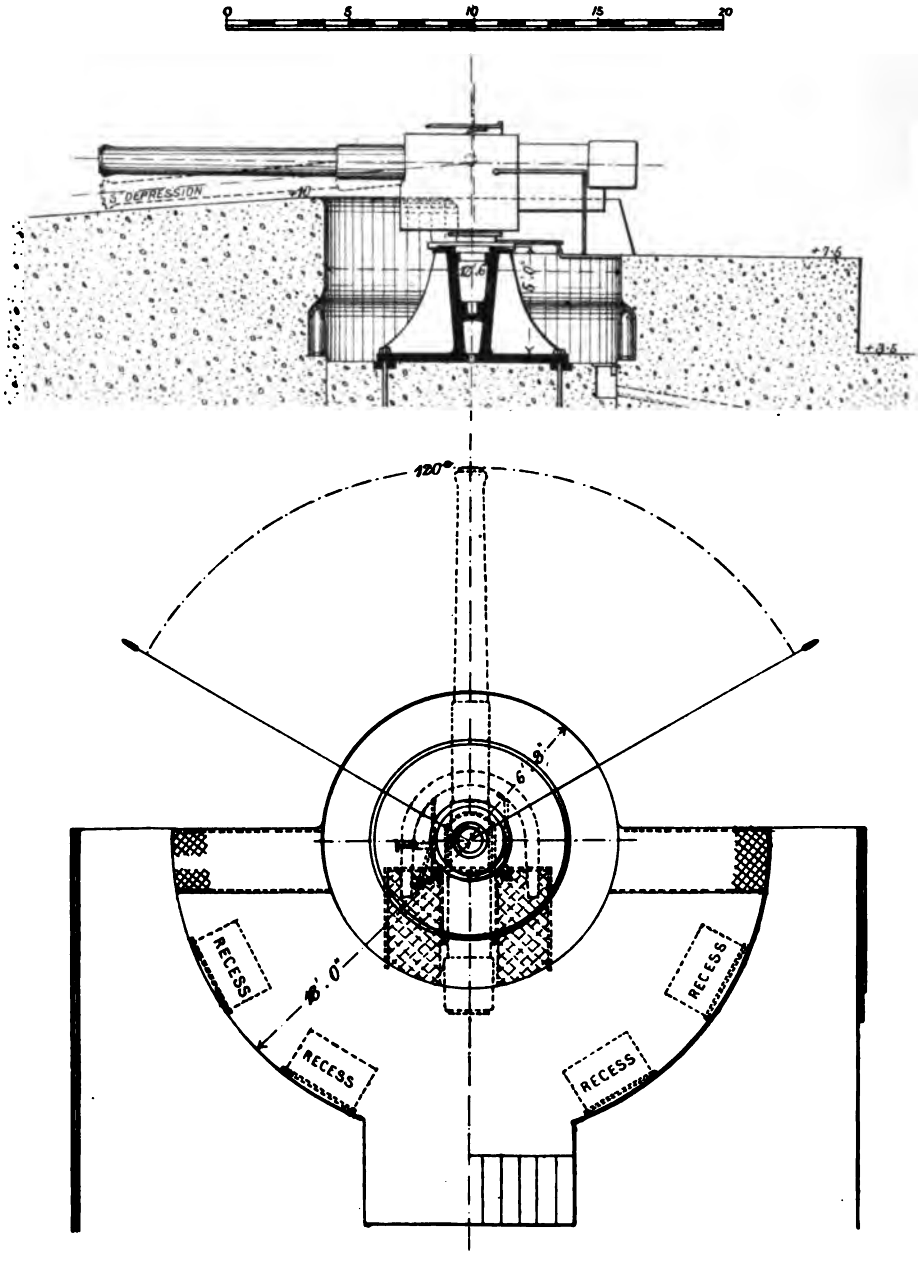
Typical Emplacement
FOR
6 Inch B.L. Gun Mark VII.

Scale, Feet.



To follow Plate.

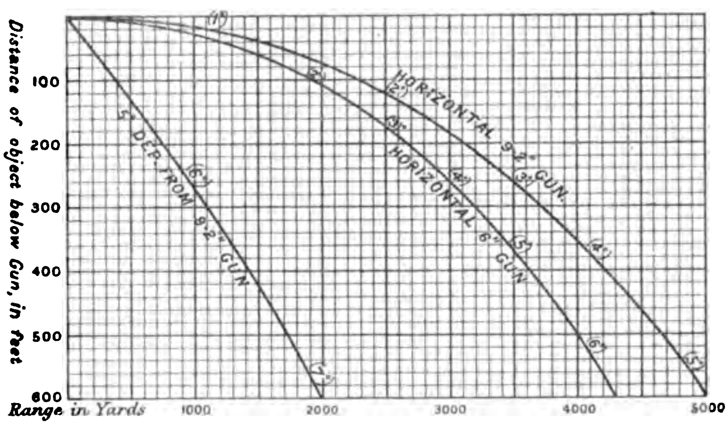
DIAGRAM 3.

TRAJECTORIES OF PROJECTILES FIRED FROM 9·2-INCH MARK XI. GUN (HORIZONTAL AND WITH 5 DEGREES DEPRESSION).

Projectile, 380 *lb.*; *Charge*, 130½ *lb. M.D. Cordite*; *M.V.*, 2,899 *f.s.*

ALSO OF PROJECTILE FROM 6-INCH MARK VII. GUN (HORIZONTAL).

Projectile, 100 *lb.*; *Charge*, 29 *lb. M.D. Cordite*; *M.V.*, 2,780 *f.s.*



N.B.—The trajectory of the 6-inch B.L. gun is approximately the same as that of the 9·2-inc gun when firing at 5 degrees depression.

Figures in brackets show the angles of tangent to the trajectory with horizontal lines.

Explanation.—This diagram gives approximately the trajectories of the 9·2-inch gun and of the 6-inch gun fired with axes horizontal, and of the former fired with 5 degrees depression.

The diagram shows that the projectile of the 9·2-inch gun fired horizontal from a height of 100 feet above the deck of a ship at 2,800 yards will have an angle of descent of about 2 degrees, and from the 6-inch gun at the same height the corresponding range would be about 1,900 yards. Similarly, at a height of 400 feet and a range of 4,200 yards the angle of descent would be a little over 4 degrees for the 9·2-inch gun, while in the case of the 6-inch gun the corresponding height and range would be 260 feet and 3,000 yards respectively.

a group should not be more than 60 yards apart, in order that the fire of both may be effectively supervised by an officer. In some cases, a single gun may require to be treated as a group.

The depression position-finder system, perfected by the late Colonel H. S. S. Watkin, C.B., R.A., enables an observer at a distance to communicate to an emplacement both the range of the ship and the angle of training, thus permitting the gun to be laid without sighting. Similarly, the distant observer can direct the laying of a group of guns upon a point on a ship's course, and can himself fire the guns electrically when the vessel reaches that point. This admirable system received for a time far too little recognition; but was subsequently, in accordance with the law of the swing of the pendulum, applied in some cases on an extravagant and wholly unnecessary scale. The general introduction of the auto-sight with a telescope renders the depression position-finder superfluous, except where guns are mounted on low sites, while at the same time conferring independence upon the gun and materially increasing the speed of fire.

"The idea of subjecting a large number of guns to the control of a single individual ensconced in a cell on a neighbouring hilltop possesses many theoretical attractions. In practice the necessary results would be delays, misunderstandings, and great loss of fire effect. The true policy of coast defence is simply to seek to obtain as many hits as possible in the shortest time; and when engaging ships in motion, the changes of conditions will be so exceedingly rapid that no single directing head can hope to follow them. The group commander alone will be able instantly to select the target which offers for a fleeting moment the best chances to his guns. To accustom him to depend upon a continuous stream of detailed instructions, telegraphed from a distance,

is dangerous. In action, if he is wise, he will certainly seize upon any opportunities that may present themselves. His training in peace ought not to be allowed to destroy his initiative and to blunt his sense of responsibility."[1]

While, therefore, the power of sending information and general directions to battery commanders by telephone is evidently necessary, it should be sparingly used for purposes of control. The observer, secure in his distant cell, will be able to take in the situation as a whole, and possibly to note a waste of ammunition on the part of a group of guns ; but, as a rule, he must be less capable than the group commander of selecting the best target momentarily available, and his interference may easily lead to a check in the speed of fire and to lost opportunities. Cases will occur, however, where the position-finder may enable fire to be directed on ships concealed by mist from the view of the gun-layer ; while, used as a range-finder, the Watkin instrument will be valuable where it has been necessary to mount guns on very low sites.

Where coast defences are required to defend the entrance to an anchorage liable to torpedo-boat attack, light quick-firing guns will be required to supplement the heavy and machine armament. It has recently been suggested that the 12-pr. shell is not heavy enough to stop torpedo craft, and that ships, therefore, need a larger gun (4-inch or 4·7-inch) for their protection. The experience of the Russo-Japanese War, in which torpedo-boat attacks appear to have been repelled without difficulty, except when a ship had been previously rendered helpless, does not bear out this view. The positions of the anti-torpedo-boat guns at the entrance to Port Arthur are shown approximately in

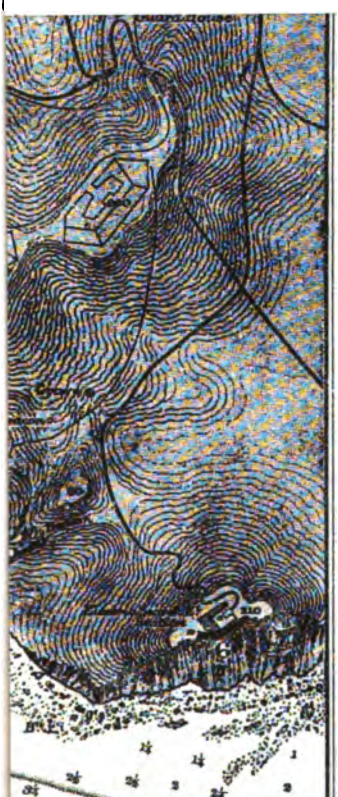
[1] "Mountings for Coast Artillery," by the writer, Proceedings R.A. Institution, vol. xxiv., 1897. See also "Auto-sighting," *ibid.*, March, 1899.

Plate XXXII.; but, as no attempt was made by the Japanese to enter the harbour, there is no evidence as to the effect of these guns.[1] The 12-pr. with an auto-sight is capable of delivering a very accurate fire up to at least 2,500 yards with a speed of fully ten rounds per minute, and its shells would amply suffice to disable a destroyer, which is necessarily a flimsy craft, full of unprotected gear essential to its combatant rôle.[2] The hail of small shells from a pom-pom on the deck might suffice to render it *hors de combat*; but, unfortunately, the experiment has not been tried.

The selection of sites for anti-torpedo-boat guns should be such as to give them the maximum advantage, and as they will be required mainly at night, the question of the provision of electric lights (p. 268) must be simultaneously considered. It will, therefore, follow in some cases that these guns may be at some distance from the main armament. Their small size will render concealment easy, and it will generally be unnecessary to give them a field of fire beyond the area covered by the electric light. A height of 50 feet above sea-level will suffice to reap the advantage of the auto-sight. A group of four 12-prs. would form an officer's command, and as the guns' crews will have to sleep close to their armament, shelters should be provided in cold climates. As the efficiency of the fire of these guns depends upon the training and alertness of the men, the opportunities being necessarily brief, interference by superior authority at a distance is eminently undesirable. A battery of quick-firers should, however, be provided with telephones, so that information and warning can be instantly transmitted.

[1] This light armament may have contributed to the failure of the Japanese blocking vessels.

[2] The Japanese destroyers seem to have greatly feared the 12-pr., as was natural.



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4.	...	2—4-pr. Q.-F. guns.
5.	...	4—6-pr. ,, ..
6.	...	5—10-in. ..
		2—6-pr. Q.-F. ,,
		2—Search lights.

N.B.—The positions of guns, etc., are approximately correct.

Formal coast batteries in which Artillery and Infantry defence is combined should be avoided,[1] and the fascinations of geometrical symmetry must be resisted. Where sites are exceptionally restricted and isolated, however, the combination may be inevitable, and a good obstacle, such as a small fence or entanglement under rifle and machine-gun fire, will suffice for self-defence. The "keep" principle, which played a considerable part in the French wars, is equally applicable at the present day. A small redoubt commanding a group of gun emplacements can replace the towers which figured on the coasts of France, Italy, and Corsica, and will prove an effectual deterrent to the operations of a ship's landing-party. Assaults, always dangerous, become specially so in face of magazine rifles and machine guns, when they have to be undertaken, without effective preparation, by a force completely *en l'air*. Where a considerable number of troops are available—as, for example, at some of the Australian ports—Infantry defences of a permanent nature may generally be dispensed with altogether, light field works being thrown up when required. In all cases the provision of machine guns, easily transported, is most desirable, both to enable a landing-party to be opposed on the water, and to save personnel.

Attempts to embody barracks, intended for peace occupation, in the design of coast batteries required solely for war should be abandoned. If there is no accommodation in the immediate neighbourhood, huts should be built near at hand, and must take their chance if necessarily visible from the sea. Every coast battery should, however, be provided with good shelters close to the guns, and protected by the parapet or the natural ground. Such shelters, not being required to resist high-angle fire (p. 247),

[1] The spectacle, which can be seen in this country, of a vast fort with the guns forming its *raison d'être* placed outside is instructive.

need not be bombproof in the ordinary sense. A water-supply and the means of simple cooking are necessary. Shells can be stored in perfect safety under the parapet of an emplacement (see Plates XXX. and XXXI.); and adjacent recesses capable of holding a supply of cartridges in air-tight cases should be constructed. A parapet 35 feet thick in front of an emplacement will amply suffice, and study of the behaviour of projectiles in earth will prevent undue expenditure upon deeply sunk magazines. The safety of a magazine against an enemy's fire can easily and cheaply be secured; and where cordite only has to be stored, the design can be of a simple character.

CHAPTER XVIII

ADJUNCTS OF COAST DEFENCE — SUBMARINE MINES—BLOCKADE MINES — ELECTRIC LIGHTS — SUBMARINES —ORGANIZATION—CONCLUSION

While the gun is, and always has been, the primary weapon of coast defence, various adjuncts have been adopted or proposed, and of such adjuncts the submarine mine has been by far the most widely applied. It is, therefore, natural that the recent decision to withdraw submarine mines from British mercantile ports, the defences of which are under the control of the War Office,[1] should have caused misgivings in some quarters. The abandonment of any method of protection to which the public has become accustomed must inevitably give rise to a temporary sense of diminished security, and it is desirable to refer briefly to the reasons which have governed the decision.

The evolution of the submarine mine in this country is an interesting study. From a modest beginning—a "Floating Obstructions Committee," assembled in 1863—an elaborate and expensive system had been gradually developed. Admirable ingenuity was displayed in working out the technical details, and the British system was probably

[1] At other British ports at which this system of defence has been provided, such as those of India and Australasia, submarine mines will probably disappear, as the difficulty of maintaining elaborate technical appliances not in use in the Mother Country would be considerable.

one of the best that has been devised. A high standard of technical efficiency was thus attained; but the suitability of submarine mines to the purposes of war in varying conditions was never discussed. Principles were ignored, and, as frequently happens, the lightly assumed advantages of an adjunct of defence were permitted to dictate a policy which entailed wide-reaching results and large expenditure.

The experience of the American Civil War, which has been examined elsewhere,[1] was unfortunately regarded as applicable to the absolutely different conditions of the British Empire, and there was no attempt to deduce broad lessons from the available historical materials.

The most recent experience, fully confirming that of earlier date, has been distinctly unfavourable to the employment of submarine mines for the defence of British harbours.

In the Spanish-American War the unreasoning panic on the seaboard of the United States, which Captain Mahan has justly stigmatized, led to the laying down of submarine mines at New York and Boston as a protection against the hapless squadron of Admiral Cervera, about to be despatched to certain destruction, as its commander was well aware. Thus the proceedings of the French in 1870, when minefields were actually laid out at Cherbourg and Toulon, although there was no German squadron in the Atlantic or Mediterranean, were faithfully reproduced. In both the French and the American cases, the only effect of the minefields was to inflict inconvenience on the nations which resorted to this system of defence. The Prussians also laid down mines at the entrances to their ports in 1870, with the only result that some of their ships were captured, being unable or afraid to enter, and that several lives were lost in the subsequent removal of the mines.

[1] "Submarine Mines in Relation to War," by the writer: "The Navy and the Nation" (Murray, 1897).

In the channel of approach to Santiago the Spaniards laid down two minefields. The mines are stated to have been both of contact and observation type,[1] and one of them appears to have injured the *Merimac*. If, however, the advanced minefield had fulfilled its purpose, it would only have succeeded in furthering the object which the Americans had in view—that of blocking the entrance.

The Japanese, in their war with China in 1894, had no inducement to attempt to enter the harbour of Port Arthur until the defences had been captured, although a Chinese minefield, if it existed there, could safely be regarded as inefficient. The Russians in the late war established orthodox minefields at Port Arthur and Vladivostock, and the Japanese also put down mines at the entrances of some of their ports. The minefield at Port Arthur was evidently useless. From its retired position it could not provide the smallest protection against bombardment, while the object of the Japanese was to block the entrance—an object which the Russian mines would have facilitated[2] if they had come into play. On the other hand, the Russian fleet was obviously unable to make any pretence of attacking Japanese ports, and the mines there available were as useless as those installed at Port Arthur.

The question of the suitability of mining defence to British ports resolves itself into a consideration of the following points :

1. Are there any British ports which an enemy's ships of considerable draught could reasonably be expected to attempt to enter if opposed by gun defence ?

2. Would not the blocking of a fairway, which might be

[1] Captain Severo Gómez Núñez.

[2] It is interesting to note that, in the two most recent wars, attempts were made by the attacking force, not to enter the enemy's ports, but to prevent the egress of his ships by physical obstructions.

the only result attainable by a minefield if it proved perfectly effective, inflict a greater injury on British interests than an attempt—obviously improbable—to commit a large ship of war to narrow and difficult waters ?

3. As the free ingress and egress of British ships at British ports during war is evidently essential, ought restraints and possible risks[1] to be gratuitously imposed upon them ?

These are purely naval questions, involving considerations of the employment of fleets on the high seas and of the possibilities open to the inferior of two naval belligerents. The answers must be sought in the teaching of naval war, and the researches of the electrical expert have no bearing upon them. When it is remembered that an installation of submarine mines was established far up the Hooghly and at the mouth of the Tyne, was begun at the mouth of the Liffey, and was proposed for a length of about five miles in the Bristol Channel, the dangers of allowing naval policy to be dictated by submarine enthusiasts will be understood. In a matter of this nature, the nation must trust to the opinions of the Admiralty as the custodian of its waterways, and any misgivings to which the abolition of mines may give rise will be dispelled by calm consideration of facts. Foreign Powers will doubtless continue to maintain their mining paraphernalia, which need not in the least affect our nerves. Minefields can be used in profusion and without disadvantage by nations able to contemplate with equanimity the closing of their ports in war. The hydrographic limitations are, however, such that they can, as a

[1] In the war of 1870-71 German ships were captured because unable to enter their own—mined—ports. The experiment of laying down a complete minefield and of working the traffic through it has never been tried in this country, and although the contrary has been asserted, it is clear that any mine containing a detonator might be fired if cut through by a ship's screw.

rule, be employed only to deny channels which an enemy's large ships could have no occasion to enter, and would certainly not attempt to enter until the command of the sea had been established, while against torpedo craft they constitute no adequate protection.

Locomotive torpedoes controlled from the shore have not come into general favour. The most effective of such weapons—the Brennan torpedo, of which a small number were installed in our coast defences—has now been abandoned, being evidently superfluous.

Blockade Mines.

The extensive use of blockade mines in the Russo-Japanese War, with destructive effect, caused some surprise in this country, where the possible employment of these dangerous appliances had been too little regarded. Foreign Powers, however, had provided themselves with contact mines of various patterns in considerable numbers, and their navies had been exercised in laying them out. The blockade mines employed by both Russians and Japanese in the China Sea appear to have been both of floating and of anchored types, and the results obtained were remarkable. Excluding small craft and merchant vessels, one Russian battleship and two Japanese battleships and four cruisers were sunk. Whether any of these ships were lost by striking their own mines cannot be known, but in the circumstances this was quite possible. The heaviest loss naturally fell upon the Japanese Navy, which was constantly cruising, and stray mines were discovered, and in some cases sank ships, many months after the conclusion of peace. Whether any international agreement limiting the use of blockade mines to territorial waters, and stipulating that they should be anchored and should automatically become innocuous after a time, can be arrived at is uncertain; but at least it is clear

that their employment in waters frequented by the shipping of all maritime Powers would incur universal reprobation, and might drive powerful neutrals into belligerency. A type of anchored mine, which is designed so as to sink if it breaks adrift, is less open to objection on humanitarian grounds, and may probably be used with a view to closing an enemy's ports. It could, however, be employed only in comparatively shallow waters. To prevent an enemy from sowing the approaches to British ports with blockade mines must be primarily the duty of the Navy; but, in some cases, guns on shore may be required to repel mine-laying vessels and to prevent attempts to block a fairway by sinking a ship, which will generally be a most difficult operation, as shown at Santiago and Port Arthur.

Electric Lights.

The removal of submarine mines from the approaches of British ports entails a reconsideration of the employment of electric lights in connection with coast defence. Mine-fields having been regarded as liable to be tampered with by an enterprising enemy, large numbers of electric lights, installed for their illumination, are no longer required for this purpose. Attack by torpedo craft, however, still demands attention at certain specially important ports within striking distance of an enemy's bases;[1] while, as pointed out, attempts to close a channel by sinking ships at night may need to be provided against.

Torpedo craft constitute a danger only to warships and mercantile vessels afloat and to dock caissons. Shipping can frequently be protected by booms held in readiness to close certain portions of a harbour which have constricted entrances, or improvised to meet a temporary

[1] Torpedo-boat attacks on harbours containing mercantile shipping will usually involve the risk of destroying neutral vessels.

need, as in the case of the base skilfully created by the Japanese at the Elliott Islands. The nets carried by most large warships also serve as independent means of defence. Caissons, if not within the boom-enclosed waters, can be protected with little difficulty. Where it may be necessary for warships to lie at night outside the boom defence in harbours exposed to torpedo-boat attack, and where the channel of approach can be illuminated effectually, additional means of protection, and at least of warning, may be afforded by an electric-light installation associated with quick-firing guns. In such a case, the best arrangement seems to be the provision of divergent fixed beams covering an advanced belt of water under gun fire, with movable beams in rear capable of picking up torpedo craft in the illuminated area and of following them up-channel. It must be remembered, however, that in favourable conditions the effective range of the light does not exceed about 1,800 to 2,000 yards, that to ensure accurate Artillery fire it is generally necessary to be able to distinguish the water-line at the bows at least, and that a slight fog will render all observation impossible.

At Santiago it was the object of the Spaniards to keep the entrance of the harbour dark. On the other hand, the blockading ships kept their lights on the entrance, in fear that the squadron of Admiral Cervera might attempt to escape by night.

At Port Arthur the Russian electric lights[1] seem to have

[1] The position of the searchlights is shown in the map of Port Arthur. The two southernmost lights were too far away to illuminate the direct approaches, and were apparently intended to pick up boats steaming near the coastline, or possibly to frustrate the attack of a landing-party on the somewhat isolated coast defences on this side. In addition, the Russians sometimes anchored a ship near the entrance of the harbour. Thus, the *Retvisan* was in this position on the night of the 23rd February, 1904, and contributed to the failure of the Japanese.

picked up the blocking ships effectively, and the latter were either disabled by shell fire, or were driven on shore by the difficulties of navigating with the beam upon them.

Whether the Japanese could have effected their purpose of blocking the entrance if there had been no electric lights on shore is doubtful, and no navy is likely to succeed where they failed in an operation of this nature. The chart of Port Arthur, showing approximately the positions of the wrecked Japanese blocking ships, is reproduced in Plate XXXII.

That warships, with the aid of their own electric lights, would attempt to engage coast defences at night is most improbable, as no result could be expected. Thus the electric light must be regarded mainly as a protection against torpedo craft and blocking vessels, and should be so placed as to give the greatest possible assistance to the anti-torpedo-boat armament. A low site, alike for a fixed beam and for a searchlight, will be best, and upon their position relatively to the guns the efficiency of the fire of the latter will mainly depend.

The employment of electric lights in connection with coast defences is by no means an unqualified advantage. If injudiciously disposed, they may serve as leading marks, assisting an enemy's torpedo craft to find their objective, which might otherwise be a difficult task. The questions as to where installations are desirable, and whether fixed or movable beams are best suited to the conditions, must, therefore, be decided mainly by naval opinion.

In the following cases, electric lights may be useful :

1. Where a narrow channel leads into interior waters, a belt of illumination will serve to give warning of the approach of hostile vessels, and to enable fire to be brought to bear upon them. Movable beams in rear will provide

the means of following and continuing fire upon any vessels which have passed such a belt.

2. An illuminated area in front of a boom, with quick-firing guns bearing upon it, will prevent attempts to destroy the boom by attaching explosives to it. On the other hand, such illumination, unless well in advance, will clearly reveal the position of the boom.

3. In the case of very narrow channels, where the conditions are such that an enemy might attempt to employ blocking ships, the use of electric lights may serve the double purpose of confusing navigation and of enabling rapid shell fire to be brought to bear. As in Case 1, the illuminated area should be well in advance of the position most favourable for blocking, so as not to assist an enemy in finding his objective.

Experience and reason indicate that blocking operations are feasible only in exceptional circumstances. The Japanese failed after the most determined efforts at Port Arthur. The attempt of the *Merimac* at Santiago was equally unsuccessful. To sink a ship exactly in the right place—the neck of a natural channel or the opening in a breakwater—is necessarily most difficult, while the inferior naval Power will generally find it impossible to make the attempt. Unless the Russian fleet at Port Arthur had abandoned all idea of an offensive rôle, the blocking operations would not have been undertaken.

Electric lights are useless in thick weather, and their value in many localities is thus heavily discounted. The main consideration in deciding to employ them at British ports is how far they can help to frustrate operations which an inferior navy is reasonably likely to undertake. Into this question geographical and other conditions enter, and clear thinking is eminently desirable. Safe and unrestricted entry of British ships into British ports being a paramount

need in war, great care in the employment of electric lights is evidently required,[1] and for this reason, as well as on economic grounds, the indiscriminate installations which have found favour should be subjected to searching revision, bringing full consideration to bear from the nautical point of view. As a general principle, a weapon of defence which conditions of weather, permitting if not facilitating the operations of the attack, may render useless should be sparingly employed.

Submarine Boats.

Submarine boats and submersibles are now absorbing large expenditure, and we are becoming heavily committed to these untried weapons. The submarine is practically a torpedo-boat heavily handicapped as regards navigation, power of aiming the torpedo, and mobility, but protected by total or partial submersion during its advance to the attack. The war achievements of the torpedo-boat, which, it was announced, would revolutionize naval strategy and render the battleship obsolete, have been disappointing. The surprise attack upon the Russian squadron anchored off Port Arthur on the night of the 8th February, 1904, by which the battleships *Tsarevitch* and *Retvisan* and the cruiser *Pallada* were torpedoed, was, however, an important success, fully justifying the previous expenditure of the Japanese upon these craft.[2] If a fleet is again caught by night unprepared and at anchor in the open within striking distance of an enemy's torpedo flotilla when war

[1] Since these words were written the destroyer *Ariel* has been wrecked at the entrance to Malta Harbour, mainly by reason of a searchlight turned upon her bridge from one of the forts.

[2] The conditions closely resembled those which enabled the *Blanco Encalada* to be sunk in Caldera Bay on the 23rd April, 1891.

is imminent, this experienc will doubtless be repeated. During the subsequent course of the naval campaign the torpedo-boats, and the destroyers especially, performed useful service distinct from their proper rôle ; but, although the young Japanese officers shone in acts of daring, they were unable to realize the advantages which have been freely claimed for the torpedo. At the battle of Tsushima, the only result obtained was to sink ships which might otherwise have been added to the Japanese navy. The broad lesson of the Russo-Japanese War is that it is more difficult to deliver and more easy to repulse a torpedo-boat attack than had been imagined.

Whether the submarine will prove more generally successful, or whether, as has been the case of the torpedo-boat, it will fail to fulfil the confident expectations which have been formed of its capabilities, cannot be foretold with certainty. It is clear, however, that the menace will be considerable, and that there will be marked reluctance to manœuvre ships in waters where submarines are believed to be at hand, and which are regarded as favourable to their employment.[1] They may fairly be claimed, therefore, as useful adjuncts of coast defence, and they are open to much less objection than submarine mines. Their presence in interior waters which an enemy's ships are believed to be able to enter by running past coast batteries may act as a strong deterrent. If submarines are to be thus employed, they should take their place as veritable adjuncts in a general scheme, in place of being superimposed as excrescences upon existing means of defence. If, further, they wholly emerge from the experimental stage, and their moral effect proves to be permanent, they may evidently justify a reduction of gun armaments.

[1] A minimum depth of about 8 fathoms appears to be necessary to enable the submarine boat to manœuvre under water with safety.

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Organization.

A thorough organization of the resources of coast defences is most important, especially where the possibility of a night attack by torpedo craft must be contemplated. The effective co-operation of guns and electric lights is not easily attained, and may break down completely if the organization and the training of the personnel have not been perfected in peace-time. Frequent night exercises are essential to educate the eye, which otherwise will be completely at fault in unaccustomed conditions. The organization must include arrangements for the admission of vessels with the least delay—a vital consideration in British ports—and must provide security for patrol boats if these are employed. These, however, are matters which lie beyond the scope of this work.

It should always be remembered that ports within striking distance of an enemy's bases may be attacked at the very outset of war, and that time to make good preparations neglected in peace cannot be counted upon. If, in some respects, the design and arrangement of coast defences are now simpler than formerly, the adjustment of means to ends and the co-ordination of the various elements entail increased demands upon the brains of the Artilleryman and the Engineer.

Conclusion.

The term "Coast Defence" is used throughout this work in the restricted sense, implying local means of guarding certain limited waters. In the broad sense, the term includes the action of the national Navy on the seas, which is necessarily the ruling factor. As pointed out by Major Sarrepont, "*Si l'on vent determiner rationnellement quels*

sont les points de la côte à fortifier, il est nécessaire de tenir compte des effets du concours de la flotte nationale et de l'activité que pourra déployer la flotte ennemi."[1] The coast-line of the superior of two naval belligerents is usually immune in war, as the naval situation dominates the issues. This, however, does not justify neglect to provide local protection at important harbours. It is folly to run unnecessary risks; but, at the same time, the exaggeration of fixed defence is doubly impolitic—as a waste of public money and as a misdirection of public opinion. Superfluous Fortification at one point, by creating a false idea of proportion, inevitably produces a strong sense of insecurity at all others. The ill-conceived schemes adopted by Lord Palmerston added nothing to the national strength, and unquestionably helped to bring about a dangerous weakening of the Navy. It would be infinitely safer to abandon all local defence than to permit the Navy to sink below the necessary standard. We are, however, able to maintain the fleet as well as the moderate coast defences which alone are required. It is the duty of statesmen to insist that the latter shall be kept within reasonable bounds, to confine the technical expert within limits laid down by authority, and to disregard popular clamour, which here, as in the United States in 1898, is the natural result of ignorance or misreading of the history of war.

[1] "Les torpilles."

APPENDICES

APPENDIX A.—Sieges of the Wars of Marlborough and Eugene.

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
1	1695	Cazal.	Days. 17	Capitulated.	Bastioned *enceinte*, with strong citadel occupying about one-third of the defended area.
2	1702	Kayserwert.	57	Capitulated.	Defences comparatively weak; but communication across the river was preserved throughout the siege. "This it was that rendered that siege so long and so bloody." Defence protracted after the fortifications and the town were practically destroyed.
3	1702	Citadel of Liege.	10	Assault of the breach	Attack directed by Coehorn.
4	1702	Venlo.	24	Capitulated.	Attack directed by Coehorn. Detached Fort St. Michael on the other side of the Meuse successfully stormed.
5	1702	Landau.	84	Capitulated.	Strongly fortified.
6	1703	Brisac.	14	Capitulated.	Elaborately fortified by Vauban, and considered to be one of the strongest places in Europe. Vauban directed the attack.
7	1703	Landau.	30	Capitulated.	Strongly fortified. Besiegers' position somewhat insecure. M. de Tallard obliged to fight the battle of Spire during the siege.
8	1704	Landau.	69	Capitulated.	Fortifications newly restored and "mortar not very well settled." New works had therefore to be thrown up "even in sight of the enemy."

APPENDIX A.—SIEGES OF THE WARS OF MARLBOROUGH AND EUGENE.—*Continued.*

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
9	1705	Barcelona.	Days. 24	Capitulated.	Detached Fort Mont Jouy entered after explosion of magazine.
10	1706	Turin.	136	Relieved.	Not isolated until the last five weeks of the siege. The Duke of Savoy made careful preparations and threw up much earthwork previous to the siege, two millions of fascines being thus expended. The defence was remarkably active, guns even being taken out of the fortress and mounted in extemporized batteries during the siege.
11	1706	Ostend.	3	Capitulated.	Provided with "ten good bastions well pallisaded and wet ditches."
12	1707	Menin.	30	Capitulated.	"One of the strongest places in Flanders." "M. de Vauban had shown his utmost skill in the mighty works which he had raised for its defence; it was extremely well provided."
13	1707	Ath.	15	Capitulated.	"Fortifications were regular and in very good order."
14	1707	Toulon.	64	Siege raised.	Permanent defences below the average; but supplemented by field works. Attacked simultaneously by sea.
15	1708	Lisle.	60	Capitulated.	Excessively elaborate fortifications. "Fortified in such a manner that it was held impregnable." The duration of the defence appears to have been regarded as very exceptional, and the conduct of the siege was blamed. The Chevalier de Luxemburg was able to enter the fortress with supplies during the siege, and the besiegers' own convoys were not secure. The garrison was allowed by the terms of the capitulation to retire into the citadel, which held out for some time longer. It was further arranged that the siege of the citadel should not be carried on from the side of the town.

APPENDIX A.—Sieges of the Wars of Marlborough and Eugene.—*Continued.*

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
16	1708	Ghent.	Days. 13	Capitulated.	Very strong garrison. Special instructions sent to the Count de la Mottée to hold out to the last.
17	1708	Mons.	25	Capitulated.	Very elaborate fortifications.
18	1709	Tournay.	28	Capitulated.	Very strong. "Citadel looked upon as a masterpiece of M. de Megrigny," who was in command of it, was defended for nearly a month longer. Much mine warfare.
19	1710	Douai.	52	Capitulated.	Very active defence. The besiegers were threatened throughout the siege and driven to make lines of contravallation.
20	1710	Bethune.	46	Capitulated.	The defenders made one vigorous sally.
21	1710	St. Venant.	14	Capitulated.	"Not thoroughly fortified."
22	1710	Aire.	58	Capitulated.	"Wonderfully strong by nature." Provided with "ten bastions, as many half-moons, two hornworks."
23	1711	Bouchain.	15	Capitulated.	First siege. By the Allies. Very strong. Garrison received assistance from the French outside.
24	1711	Quesnoy.	17	Capitulated.	First siege. By the Allies. "A very strong town." Siege prosecuted "with all imaginable vigour."

APPENDIX A.—SIEGES OF THE WARS OF MARLBOROUGH AND EUGENE.—*Continued.*

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
25	1712	Quesnoy.	Days. 27	Capitulated.	Second siege. By the French. "A warmer siege was never seen."
26	1712	Bouchain.	16	Capitulated.	Second siege. By the French.
27	1713	Landau.	56	Capitulated.	Very strong. Well prepared for defence, and new works added.
28	1713	Friburg.	30	Capitulated.	"One of the strongest places in Germany." *Enceinte*, Castle and three strong forts. The latter held out for a time after the fall of the town, but were apparently not besieged. The defence was extremely vigorous.
29	1716	Temisvar.	43	Capitulated.	Wooden fortifications, "vast beams" 15 inches to 18 inches in diameter, and large wet ditches. The Palanka, or outer line, was breached and successfully assaulted. Trenches then opened against the town. Held by the Turks. Defence purely passive.
30	1717	Belgrade.	58	Bombardment and defeat of relieving force.	The bombardment did not begin till five weeks after investment. Prince Eugene, commanding the besiegers, was shut in by the Turks outside, whom he defeated. The fortress then surrendered.
31	1734	Philipsbourg.	46	Capitulated.	Very elaborate fortifications and wet ditches. Crownwork stormed.

N.B.—"Capitulated" in the above Table implies that the fortress was surrendered without awaiting the assault of the breach. This does not mean, however, that partial assaults were not delivered from the trenches in order to effect lodgments in the covered way, etc.

APPENDIX B.—Sieges of the Peninsular War.

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
1	1811	Olivença	Days. 5	Capitulated.	Breach "nearly practicable." Nine regular bastioned forts. Garrison only 400 strong.
2	1811	Badajos (1)	39	Siege raised.	Bastioned trace; with three large outworks. This siege was directed mainly against one detached work, Christoval. This work assaulted on night of 6th–7th June. Attacking party got into the ditch, the fort being "evidently weakly manned." Breach proved "perfectly impracticable," because the garrison had removed débris at foot. Attempt to escalade failed. Second assault night of 9th–10th June. Escalade again failed; breach still impracticable, since the "effects of a day's battering" were neutralized "by the work of a few men in the night."
3	1812	Ciudad Rodrigo.	12	Assault of breach.	"A small and by no means first-rate fortress." Outlying redoubt Renaud taken night of 8th–9th; no obstacle in ditch, no revetted scarp, no gorge ditch. Two breaches formed in main defences; both ultimately carried. Little breach "not obstinately defended," and not retrenched. Great breach retrenched and defended with success till the other storming party came down on the rear of the defenders. Resources of besiegers on this occasion "infinitely greater than for other attacks."
4	1812	Badajos (2).	30	Escalade and assault.	Defences improved since first siege. Deatched fort Picurina, taken by assault of night 25th–26th March, had a retrenched guard house in the interior, which appears to have been absolutely useless. Great attack, night of 6th–7th April. Assault on breaches failed, though

APPENDIX B.—SIEGES OF THE PENINSULAR WAR.—*Continued.*

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
4	1812	Badajos (2).	Days. 30	Escalade and assault.	they were about 500 feet in extent, "the greater part of it as good as can be found." Breach in "curtain particularly low and easy of ascent." "The simplest precautions had not been adopted behind it." Two escalading parties succeeded, one of them eventually turning the breaches. Loss about equal to whole strength of garrison.
5	1812	Fort Napoleon (Almaraz).	—	Taken by escalade.	A simple redoubt with an interior tower as keep entered by a drawbridge, "escaladed by daylight," the troops "undiscovered till completely formed." Attacking party followed defenders into their keep.
6	1812	Salamanca.	10	Bombardment and assault.	Defences consisted mainly of a convent in an angle of the "old town wall" placed in a state of defence. Beyond the river two other convents similarly treated. Garrison only 800 men. Attempt to blow in counterscarp opposite citadel failed owing to barking of dog. Attempted escalade of Gayetana failed; "no one mounted" the ladders, and party retired with loss. Finally Gayetana was carried by the gorge, "the garrison making little or no resistance." Convent of Vicenti entered by Portuguese Caçadores "without opposition." The besiegers were short of ammunition.
7	1812	Retiro (Madrid).	—	Practically made no defence.	Three lines of defence. Star Fort. Park wall and buildings with flèches. Bastioned line on field profile. Outer line forced without opposition in the night. Garrison about 2,000 strong then surrendered.

APPENDIX B.—SIEGES OF THE PENINSULAR WAR.—*Continued.*

No.	Year.	Fortress.	Duration of Siege.	How taken.	Remarks.
8	1812	Burgos.	Days. 34	Siege raised.	"A very insignificant fortress;" but position naturally strong. Steep conical hill with three lines of exposed walls and a recently-built casemated battery round the old keep at the top. Large detached fort, St. Michael, across a ravine and nearly on a level with the keep. Night attack 19th–20th September on Fort St. Michael. Two attempts to escalade right and left demi-bastions failed. Fort taken by escalading the gorge palisades. Attempt to escalade outer line, night 22nd–23rd September; five ladders raised "almost unopposed." "Several gallant attempts" made. Failure complete. Two breaches made by mining, and lodgments effected—one of which immediately destroyed by a sortie. Sapping towards second line adopted, checked by a sortie. Breach in second line carried on 18th October, and at the same time an escalading party succeeded in forcing the parapet. Both parties driven off by the defenders and attack failed. Siege then raised. The appliances of the besiegers were miserably inadequate, and small-arm ammunition ran short.
9	1813	St. Sebastian.	Altogether 51, but practically two sieges.	Assault of breach.	Land front across isthmus bastioned trace with a large hornwork, etc. On side of River Urumea merely a wall with round towers, between two of which breach was made and assaulted on 25th July. Breach easily occupied; but defenders drove storming party out with heavy loss. The efforts on the breach were "not very obstinate nor very persevering." Same breach stormed on 31st August, and place fell after desperate fighting. Loss to the attack about 2,000 men.

APPENDIX C.—Peninsular Sieges. Breaches Assaulted.

Siege.	Date.	Place.	Result.	Remarks.
Badajos.	1811 Night, 6th–7th June.	Ft. Christoval.	Failure.	Storming party easily got into the ditch, the fort being "evidently weakly manned." Breach found "perfectly impracticable," because the defenders had removed débris from its foot. Garrison in fort only 75 men.
	Night. 9th–10th June.	Do.	Do.	Attempt defeated by the "immense number of shells and combustibles rolled down from the parapet." No authentic account could be obtained of the proceedings of the party after they descended into the ditch.
Ciudad Rodrigo.	1812 Night, 19th–20th January.	*Enceinte* Little breach.	Success.	"Not obstinately disputed" and not retrenched. Counterscarp only 11 feet high, hay bags thrown down for men to jump upon.
		Great breach.	Do.	Extemporized retrenchment. Fighting very severe. Defenders "suddenly relaxed" in their efforts, doubtless because the advance of the other storming party threatened their rear. Hay bags used to enable men to jump into ditch.
Badajos.	1812 Night, 6th–7th April.	Flank of Santa Maria. Bastion.	Failure.	Storming party lost their way and got into confusion; irregular assault delivered on the breach, a few men only reaching the summit which had been retrenched. Attack failed and troops withdrawn. Defenders' rear subsequently turned by party which escaladed St. Vicente Bastion.
		Curtain.	Do.	"Particularly low and easy of ascent." "The simplest precaution had not been adopted behind it."
Burgos.	1812 Night 29th–30th September.	Outer wall.	Failure.	Breach made by explosion of a mine. Assaulting party missed the way and only five men ascended. Breach then defended "so as to preclude all hope of success."

APPENDIX C.—Peninsular Sieges. Breaches Assaulted.—*Continued.*

Siege.	Date.	Place.	Result.	Remarks.
Burgos.	1812 Night, 4th–5th October.	Outer wall. Old breach.	Success.	Old breach enlarged to 60 feet by artillery fire. Breach retaken by defenders on 5th October, with little loss, and lodgment destroyed.
		New breach.	Do.	New breach made by mine.
	1812. 18th October.	2nd Line.	Failure.	Breach taken, but storming party immediately driven out.
St. Sebastian.	1813 25th July.	Wall, facing Uurmea.	Failure.	Breach not retrenched. Occupied by storming party, which was immediately driven back. Efforts on the breach "not very obstinate nor very persevering."
	31st August.	Do.	Success.	Breach retrenched. Severe fighting. Loss about 2,000.

APPENDIX D.—Peninsular Sieges. Escalading Operations.

Siege.	Date.	Place.	Result.	Remarks.
Badajos.	1811 Night, 6th–7th June.	Fort. Christoval.	Failure.	Ladders too short for a 20-foot scarp. "Impracticable attempts" were persevered in for "an hour." Garrison in fort only 75 men.
	9th–10th June.	Do.	Do.	Party descended into the ditch "without much loss." "Every one who succeeded in reaching the parapet was instantly bayoneted down."

APPENDIX D.—PENINSULAR SIEGES. ESCALADING OPERATIONS.—*Continued.*

Siege.	Date.	Place.	Result.	Remarks.
Badajos.	1812 Night, 25th–26th March.	Picurina Lunette.	Success.	Scarp 14 feet with fraises. Gorge defended principally by palisades. Escaladed simultaneously on flank at gorge.
	6th–7th April.	Castle	Do.	Loss about 600.
		St. Roque Lunette.	Do.	Practically unopposed.
	Do.	St. Vicente Bastion.	Do.	Party moved along rampart to turn the breaches; but meeting resistance an unaccountable "panic took place, and all were driven back." The reserve, which remained at the point escaladed, restored order, and all advanced, successfully turning the breaches.
Almaraz.	1812 19th May.	Fort Napoleon.	Success.	Three parties; "undiscovered till completely formed." "As soon as 15 or 20 men were on the top of the parapet" the defenders retreated over a narrow bridge into their keep, the storming party following.
Salamanca.	1812 Night, 23rd–24th June.	Gayetana Convent.	Failure.	"No one mounted the ladders," and the party retired with a loss of 120 men.
Burgos.	1812 19th–20th September.	Fort St. Michael.	Failure.	Two parties. On left the ladders were placed by Highlanders, but the Portuguese refused to enter the ditch.
		Do. Gorge Palisade.	Success.	"Little opposition." Line of palisades only.
	22nd–23rd September.	Outer Wall *Enceinte.*	Failure.	Scarp 23 to 25 feet high. "Five ladders raised almost unopposed." "Several gallant attempts made."
	18th October.	2nd line.	Do.	Escalading party reached parapet and "formed" there; but were immediately driven back.

APPENDIX E.—Siege Operations of Franco-German War, 1870–71.

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
1	Lichtenberg.	10th Aug.	Days. 1	Bombardment (field guns).	Old castle in the Vosges. *Enceinte* with deep revetted ditch. Very little bombproof cover. Garrison 280, of whom 240 were fugitives from Wörth. Surrendered after 1,300 rounds, which caused fires to break out in interior.
2	Lützelstein.	9th Aug.	*Nil.*	—	Old mountain fort partially in ruins. Evacuated after the battles of Weissenburg, Wörth, and Spicheren.
3	Marsal.	14th Aug.	½	Threat of bombardment (field guns).	Seven bastions; wet ditches. Capitulated on threat of field-gun bombardment; only 21 rounds fired. Garrison "16 officers and several hundred men."
4	Vitry.	25th Aug.	*Nil.*	Threat of bombardment (field guns).	Nine irregular bastions; no casemates or outworks; no preparations for defence. Commands St. Dizier-Chalons railway. Garrison 300 men, "all Gardes Mobiles," who had not yet received their clothing.
5	Pfalzburg.	12th Dec.	94	Bombardment (field guns). Provisions ran out.	Six regular bastions with ravelins; good casemate accommodation. "Perfectly secure against assault." Bombarded by 60 field guns (24 heavy) of 12th Division, 6th Army Corps, on 14th; the guns being placed in batteries; about 1,800 rounds fired. Houses much injured; defences hardly touched. Germans then left the fortress, leaving small force in observation. Formally invested 19th August. Regular siege contemplated, but given up. Heavily bombarded 25th November. Provisions would have run out earlier, but for the accidental arrival of a convoy after Wörth.

APPENDIX E.—SIEGE OPERATIONS OF FRANCO-GERMAN WAR, 1870-71.—*Continued.*

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
			Days.		
6	Bitsch.	—	never	taken.	Built in 1741 and subsequently improved. Upper fort strongly built on sandstone rock, with a lower bastioned *enceinte* enclosing tower. Citadel with flanked ditches. Exceptional amount of bombproof cover. A few rounds fired at the fortress on 8th August. Second Bavarian corps compelled to pass round it in three forced marches over roads so bad that infantry had to move in file. Bombardment began 23rd August, and carried on during succeeding days. On 11th September, bombardment recommenced with addition of 16 heavy siege guns and 4 mortars. Results "inconsiderable," but town suffered greatly; subsequently the fortress was merely observed till end of war. Garrison about 3,000 strong, commanded by Lieut.-Colonel Theyssier, made several sorties.
7	Toul.	24th Sept.	37	Blockade and bombardment (siege and field guns). Artillery ammunition exhausted.	Bastioned monagon; no outworks; no casemates. A few blindages made on the ramparts. Garrison lodged in private houses and huts. Position very important as barring the Strasburg-Paris line, which was much needed to bring up stores before Paris. The "complete and excellent railway organization became paralyzed at Toul." First summoned to surrender 14th August. Bombarded by two field batteries of 4th Army Corps on 17th August. Invested. Bombarded on 23rd August and subsequent days. Heavy smooth-bore guns brought up from Marsal with much difficulty, and fortress again bombarded 9th and 10th September. Besiegers reinforced on 13th September. Bombarded on 17th and 18th September by seven field batteries and ten French guns from Marsal. Siege train arrived 20th September. Intention to breach and then attack from a parallel at 500 yards from the fortress. Siege guns opened 23rd September.

APPENDIX E.—SIEGE OPERATIONS OF FRANCO-GERMAN WAR, 1870–71.—*Continued.*

No.	Name.	Date of surrender.	Resistance.	Cause of Surrender.	Remarks.
7	Toul.	24th Sept.	Days. 37	Blockade, etc.	"From the first no great result was anticipated from the fire of the siege artillery." Plantations on glacis prevented besiegers from seeing into the fortress, which was, however, looked into at 2,300 yards from Mount St. Michael "in a manner scarcely credible." Garrison about 2,300, "most of them Gardes Mobiles." Artillery ammunition all exhausted.
8	Laon.	9th Sept.	*Nil.*	Internal dissension.	Situated on an isolated hill 262 feet high. Citadel strengthened by Louis Philippe. Commands junction of Paris-Rheims and Soissons-Rheims railway. "Open dissensions between Commandant, the Prefect, the Mayor, and the Gardes Mobiles," of whom the garrison was almost entirely composed. The magazine blew up just as the citadel had been surrendered, causing much loss.
9	Strasburg.	27th Sept.	45	Regular siege.	Elaborate bastioned *enceinte* with hornworks and advanced lunettes; citadel with 5 bastioned fronts built by Vauban in 1685. Bomb-proof cover everywhere insufficient. Ditches partially wet. "Everywhere proof against assault." Invested 12th August. Siege train of 200 guns and 100 smooth-bore mortars arrived 22nd August. Bombardment of west front begun 24th August and lasted three days. Regular siege decided upon 26th August. Siege corps nearly 60,000 strong. First parallel, 4,700 yards long, begun night 29th–30th August, at about 800 yards from glacis. Third parallel, 700 yards long, begun night of 11th–12th September. Glacis in front of lunettes 52 and 53 fully crowned night of 16th–17th September. Three mines discovered in front of lunette 53, one of them charged. Lunette 53 occupied 20th September, abandoned by French. Lunette 52 taken 21st September found to be unoccupied. Complete breach

APPENDIX E.—SIEGE OPERATIONS OF FRANCO-GERMAN WAR, 1870–71.—*Continued.*

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
9	Strasburg.	27th Sept.	Days. 45	Regular siege.	formed in bastion No. 12, 26th September. German Artillery fired 193,722 rounds; ordinary rate of fire about 6,000 rounds during twenty-four hours. Garrison surrendered 17,562 strong, including 7,000 National Guards.
10	Schlettstadt.	24th Oct.	13	Partial siege. Bombardment (siege and field guns).	Eight bastions constructed in 1673. Nine advanced lunettes at angles of glacis. Insufficient bombproof cover. Commands Strasburg-Colmar railway. Reconnoitred in September, and occasionally shelled subsequently. Closely invested 9th October. First parallel begun night of 22nd–23rd October, 700 paces from fortress, "not observed," though night was clear. Siege batteries opened 23rd with 32 guns and 12 heavy mortars. Defence brought 30 guns into action. Garrison about 2,000 strong, "for the most part drunk and employed in pillaging" on day of capitulation.
11	Neu Brisach.	10th Nov.	36	Bombardment (siege and field guns).	Regular bastioned octagon. Vauban's third system. Ample casemate accommodation. Invested about 5th October. Bombarded by field guns from 7th October. Bombardment by siege guns begun from both banks of the Rhine on 2nd November. Fort Mortier, a work 2,000 paces from Neu Brisach, and fronting towards it, surrendered with a garrison 255 strong on night of 7th–8th November. Of 7 guns in Fort Mortier, 6 dismounted. Garrison of Neu Brisach about 5,000 strong, mostly Gardes Mobiles. German siege corps about 13,000 strong, principally Landwehr. Loss of besiegers 26.
12	Sedan.	2nd Sept.	*Nil.*	Defeat of 1st September.	Old bastioned *enceinte*. Exposed revetments. Insufficient casemate cover. Commands Mézières-Montmédy railway, shelled by some Bavarian batteries late in afternoon of 1st September.

APPENDIX E.—Siege Operations of Franco-German War, 1870–71.—*Continued.*

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
			Days.		
13	Metz.	27th Oct.	67	Blockade.	Four large detached forts and five intermediate works; none of them completed. Bastioned *enceinte* with wet ditches and advanced works. Commands junction of railways to Nancy, Thionville, and Saarbruck. Preparations for defence only begun after battle of Forbach. Invested 20th August. Idea of a siege "renounced from the very first." French made two efforts to break out, bringing on battles of Noisseville 31st August and 1st September, and Woippy 7th October. Garrison surrendered 179,000 strong.
14	Verdun.	8th Nov.	43 (from 25th Sept.).	Bombardment (siege and field guns). Regular siege threatened.	Bastioned *enceinte* with citadel rebuilt by Vauban. Bombarded by field guns 24th August, and again on 25th September. French held some of the suburbs till 12th October. Siege gun bombardment (52 guns, 4 howitzers, 4 mortars) began 13th October, lasted fifty-four hours. Attempt to breach failed on account of range (2,400 paces) and inaccuracy of French 24-prs. brought from Sedan. Sortie 28th October, spiked several siege guns. Preparations for siege made after fall of Metz. German force raised to 15,000 with 140 guns. Garrison surrendered about 4,150 strong.
15	Soissons.	16th Oct.	21	Bombardment (siege and field guns). Breach.	Irregular bastioned *enceinte* "bombproof barracks entirely wanting." Commands junction of railway to Nanteuil, Laon, and Rheims. Escarps visible to foot in some places from high ground within range. Invested by 7th Landwehr Division about 24th September. Outside villages held till 9th October. Siege train (26 guns, 10 mortars) brought from Toul, opened fire 12th October. French replied with 18 guns. Practicable breach 45 to 50 paces broad, repaired by French night of 14th–15th, though "an incessant fire" was directed upon it. Garrison surrendered about 4,000 strong.

APPENDIX E.—SIEGE OPERATIONS OF FRANCO-GERMAN WAR, 1870–71.—*Continued.*

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
16	La Fère.	26th Nov.	Days. 10	Bombardment (siege and field guns).	Town wall flanked by towers "in the manner of the Middle Ages." Completely looked into from adjacent heights. Garrison "without bomb-proof cover of any sort." "No cellars" for the civil population. Commands junction on Laon-Paris railway. Closely invested 15th November. Bombardment (16 siege guns, 6 mortars) began 25th. Results overpowering. Garrison surrendered about 2,000 strong, "chiefly Gardes Mobiles."
17	Thionville.	24th Nov.	11 (from 13th Nov.).	Bombardment (siege and field guns).	Elaborate bastioned *enceinte* by Vauban and Cormontaingne astride of the Moselle. Commands Metz-Luxemburg railway. Observed from 8th August. Closely invested from 13th November. Siege park of 128 guns and 30 mortars brought up. Bombardment began 22nd November, and continued for fifty-two hours. French guns maintained their fire for first twenty-four hours, then ceased, as "garrison had to be employed almost solely in extinguishing the fires in the town." Loss on both sides extremely small. Germans, 10; French, a few killed, and 40 wounded. Garrison surrendered, about 4,000 strong.
18	Montmédy.	14th Dec.	28 (from 16th Nov.).	Bombardment (siege and field guns).	Old *enceinte* by Vauban on conical hill 200 feet high; eight irregular bastions and six ravelins; commands Sedan-Metz railway. Field gun bombardment (seven batteries of the Guard Corps) on 5th September caused loss to the garrison of 18 men. Germans then marched on. Closely invested 16th November. Bombardment by 38 siege guns, and 36 field guns, and 4 mortars, began 12th December, continued thirty hours. Effect very great, "hardly a house remained uninjured." Garrison surrendered, about 3,000 strong. German loss, 12 wounded; French loss, under 100.

APPENDIX E.—Siege Operations of Franco-German War, 1870–71.—*Continued.*

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
19	Longwy.	25th Jan.	Days. 29	Bombardment (siege and field guns). Partial regular attack.	Bastioned hexagon, circumference 2,563 yards; built by Vauban in 1680 (first system); three advanced lunettes at foot of glacis. Commands Luxemburg railway. Invested about 26th December. Siege Corps about 11,000 with a train of 40 guns and 30 mortars, exclusive of field guns. Shelled by field guns occasionally from 16th to 19th January. Bombardment began 19th January and continued till evening of 24th. Parallel began night of 21st–22nd January 1,000 paces from the fortress. Defence exceptionally vigorous. Efforts made to impede investment. Several siege guns dismounted by fire. Garrison, commanded by Colonel Manaroly (a Corsican), surrendered nearly 4,000 strong.
20	Mézière	1st Jan.	9	Bombardment (siege and field guns).	Bastioned quadrangular *enceinte* about 1,000 paces by 350 paces, "*very complicated*" and "*only of interest for the engineer.*" Commands important railway junction. Reconnoitred 2nd September. Invested about 22nd December. Siege park, 69 guns, 14 mortars, and 5 field batteries. Bombardment began 31st December, lasting 27 hours, produced great effect and set town on fire. Garrison surrendered about 2,000 strong.
21	Paris.	28th Jan.	131	Blockade and bombardment (siege and field guns).	Bastioned *enceinte*, 15 detached forts (average interval 3,500 paces) designed in 1840. Prepared for defence after defeats on the frontier. Investment complete about 19th September. Siege train, about 300 guns and mortars, with 500 rounds per piece. Bombardment of east front began 27th December; south front, 5th January; north front, 21st January. Loss of garrison, about 17,000.

APPENDIX E.—Siege Operations of Franco-German War, 1870–71.—*Continued.*

No.	Name.	Date of Surrender.	Resistance.	Cause of Surrender.	Remarks.
22	Belfort.	15th Feb.	Days. 103	Armistice signed at Versailles.	Pentagonal *enceinte*, chiefly Vauban's, third system; two detached forts and two advanced forts connected with *enceinte*. Great preparations made by Colonel Denfert of the Engineers. Commands important railway junction. Investment complete 3rd November; but investing force threatened by Bourbaki's army. Outlying villages held by French till 23rd November. Bombardment begun 3rd December. First parallel completed, 21st January; second parallel, 1st February. Les Perches, two provisional redoubts, unsuccessfully assaulted night of 26th January. Les Perches taken 8th February from crowning of glacis. Haute Perche practically undefended. Perches position then armed with 60 guns and saps pushed forward towards citadel. Armistice then supervened, and fortress was surrendered. Garrison about 17,000, mainly Gardes Mobiles. Loss of besiegers 2,100.
23	Péronne.	9th Jan.	12	Bombardment (field guns).	Irregular bastioned *enceinte* armed with smooth-bore guns only. Commands Amiens-Tergnier railway. Blockaded 27th December. Bombardment with field guns began 28th December. Town much injured. Garrison about 3,000, chiefly Mobiles.
24	Rocroy.	5th Jan.	3	Bombardment (field guns).	*Enceinte* with five bastioned fronts. Masonry exposed everywhere. No bomb-proof cover for garrison. Invested 2nd January. Bombardment by six field batteries began 5th January. Garrison 160 Gardes Mobiles and 120 Line and Engineers.

APPENDIX F

Effect of German Fire on Paris Forts on South Front, Etc.[1]

Permanent Works.

Issy.—Of the four barracks in the interior, three were burnt and one was breached and rendered uninhabitable. The two old powder magazines were not breached, but the arch was bared in one place. Of nineteen casemates in S.W. curtain, five were breached and the rest injured by the fire of the short 24-prs. This damage was due to random shots, and systematic breaching operations were "not attempted." The following guns were dismounted:

2 - -	- 16 cm. rifled.
5 - -	- 24-prs. ,,
4 - -	- 12-prs. ,,
4 - -	- 16-prs. smooth-bore.
2 - -	- 22 cm. smooth-bore Howitzers.
Total 17	

The embrasures were soon obliterated. The maximum loss in one day was three killed and eight wounded, but men deserted on account of the painful discomfort.

Vanves.—Two barracks were breached and rendered uninhabitable. Two powder magazines in the interior of the fort were also breached. The casemates were penetrated in many places, and the parapet much damaged. The rear face suffered severely from reverse fire. The following guns were dismounted:

2 - -	- 16 cm. rifled.
7 - -	- 24-prs. ,,
2 - -	- 12-prs. ,,
1 - -	- 18-pr. smooth-bore.
Total 12	

Montrouge.—Less injured generally, but gorge more severely damaged by reverse fire than that of Vanves. The débris fell into the ditch and formed an almost practicable breach.

Bicêtre and *Ivry* seem to have escaped injury.

[1] Extracted from "Belagerung von Paris," Heyde and Froese, and notes by Lieut. Fraser, R.E., in "Corps Papers," vol. xx., 1872.

Enceinte.—"The damage done was chiefly confined to the neighbourhood of the Point du Jour and the bastions near the river on the Vaugirard side." "The guns here had apparently been dismounted and the embrasures had been much injured." "The curtain was covered with shot marks, but not breached." "The salient at the Point du Jour, though well traversed, was reduced to a nearly shapeless mass of earth." "The large hollow traverses on the terreplein were in nearly every case intact, and the excellent temporary cover under them was in every case quite so."

Temporary Works.

Hautes Bruyères Redoubt "but little damaged"; all the embrasures had been repaired, and only one of the bomb-proofs showed signs of injury. The following guns were found intact in this work:

5 - -	- 16 cm. rifled.
8 - -	- 24-prs. ,,
2 - -	- 27 cm. mortars.

Park Battery of Issy "very little damaged." *Kirchoff Battery* showed no signs of injury, but had probably been repaired.

Chamart Station Battery had two guns dismounted out of six. *Mortar Battery behind embankment* intact. *Spur Battery west of Vanves, batteries east of Vanves, and battery between Vanves and Montrouge* had two guns dismounted only.

Five other temporary batteries merely showed a few shell marks. *Annex Battery west of Montrouge* suffered considerably, having neither traverses nor bomb-proofs.

General.

The damage to parapets, with the exception of embrasures "amounted to little furrows at the crest and inconsiderable craters in the exterior slope."[1] The effect of enfilade fire on the forts was considerable. Traverses rising 6 feet above the crest line gave security to one gun only.

[1] Geldern, 1872.

APPENDIX G

Range Table

9·2-inch gun, Mark XI.
Charge, 130½ pounds cordite.
Projectile, 380 pounds steel common shell.
Muzzle velocity, 2,875 ft. sec.

Range.	Elevation.		Angle of Descent.		Remaining Velocity.	Fifty per Cent. of Rounds should Fall within—		
						Length.	Breadth.	Height.
Yards.	Deg.	Min.	Deg.	Min.	Ft. Sec.	Yards.	Yards.	Feet.
1,000	0	21	0	23	2,665	9·7	0·8	0·3
1,500	0	32	0	34	2,565	—	—	—
2,000	0	44	0	48	2,465	19·9	1·0	0·9
2,500	0	57	1	4	2,367	—	—	—
3,000	1	11	1	22	2,273	30·1	1·7	2·1
3,500	1	25	1	41	2,183	—	—	—
4,000	1	40	2	2	2,095	40·2	2·8	4·2
4,500	1	56	2	27	2,010	—	—	—
5,000	2	13	2	53	1,928	—	—	—
5,500	2	31	3	21	1,848	—	—	—
6,000	2	49	3	55	1,770	59·0	5·5	12·0
6,500	3	9	4	29	1,695	—	—	—
7,000	3	31	5	8	1,624	—	—	—
7,500	3	54	5	50	1,558	—	—	—
8,000	4	19	6	38	1,495	76·9	9·0	26·7
8,500	4	45	7	31	1,436	—	—	—
9,000	5	12	8	28	1,380	—	—	—
9,500	5	39	9	28	1,330	—	—	—
10,000	6	10	10	32	1,284	91·4	14·2	51·0

A capped armour - piercing shell should penetrate Krupp armour of thickness equal to its diameter (9·2 inches) at 5,200 yards.

N.B.—This is a naval gun, not as yet mounted in coast defences.

APPENDIX H

Range Table

6-inch gun, Mark VII.
Charge, 23 pounds cordite, M.D.
Projectile, 100 pounds steel common shell.
Muzzle velocity, 2,493 ft. sec.

Range.	Elevation.		Angle of Descent.		Remaining Velocity.	Fifty per Cent. of Rounds should Fall within—		
						Length.	Breadth.	Height.
Yards.	Deg.	Min.	Deg.	Min.	Ft. Sec.	Yards.	Yards.	Feet.
1,000	0	28	0	35	2,202	22·0	0·80	0·66
1,500	0	43	0	54	2,059	22·5	0·88	1·08
2,000	1	1	1	18	1,924	23·0	1·00	1·56
2,500	1	20	1	45	1,795	23·5	1·19	2·16
3,000	1	40	2	17	1,676	24·0	1·45	2·85
3,500	2	5	2	34	1,565	24·5	1·78	3·72
4,000	2	32	3	40	1,464	25·0	2·20	4·80
4,500	3	2	4	33	1,375	25·5	2·70	6·06
5,000	3	33	5	36	1,293	26·0	3·23	7·62
5,500	4	8	6	45	1,223	27·2	3·82	9·66
6,000	4	46	8	2	1,163	29·5	4·46	12·51
6,500	5	30	9	27	1,111	33·0	5·13	16·50
7,000	6	16	11	0	1,067	37·4	5·83	21·64
7,500	7	5	12	39	1,031	42·3	6·53	28·50
8,000	7	58	14	24	1,002	47·8	7·28	36·75

A capped armour-piercing shell should penetrate Krupp armour of thickness equal to its own diameter (6 inches) at 2,950 yards.

APPENDIX I.—Armoured Cruisers.

FRANCE.

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
1	Dupuy-de-Lôme ..	6,406	20·0	1890	2 7·6″ 6 6·4″	4″	12 2·5″ and 1·8″	4″	4″	2″	Armour extends from bow to stern, from upper deck to below the water, providing (with the exception of the bow gun) protection for the ammunition supply.
2 3 4 5	Bruix .. .. Chanzy .. .. Admiral Charner .. Latouche-Tréville ..	4,800	18·2 to 19·0	1892 to 1894	2 7·6″ 6 5·5″	3¼″	4 2·5″ 4 1·8″ 4 1·4″	3¼″ to 2¼″	3¼″	2″	The armour, from bow to stern, is only carried to the height of the main deck, on which the 5·5″ guns are mounted. The 7·6″ guns have no ammunition supply protection.
6	Jeanne d'Arc ..	11,329	23·0	1899	2 7·6″ 14 5·5″	6″ 5″	16 1·8″ 8 1·4″	6″ to 3″	3″	2·2″	Differs from Bruix, the armour being carried up to the forecastle deck as far aft as the foremost funnel; this gives protection to the ammunition supply of the foremost guns only.
7 8 9	Montcalm .. .. Gueydon .. .. Dupetit-Thouars ..	9,517	21·0	1899 to 1901	2 7·6″ 8 6·4″	6″ 3¼″	4 3·9″ 16 1·8″ 6 1·4″	6″ to 2¼″	3¼″	2″	The bow armour is only carried to the upper deck, and ammunition supply protection is provided for the 7·6″ and two foremost 6·4″ guns.

APPENDIX I (*continued*).—ARMOURED CRUISERS: FRANCE (*continued*).

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
10 11 12	Desaix Dupleix Kléber	7,700	21·0 to 21·7	1900 to 1902	8 6·4"	3½"	4 3·9" 10 1·8" 4 1·4"	4" to 3"	—	2¾"	These vessels have no armour above the belt, which, however, is slightly broadened at the bow and reduced at the stern. The guns, which are mounted in four turrets, have protected ammunition supplies.
13 14 15 16	Admiral Aube Condé Gloire Marseillaise	10,014	21·0	1900 to 1902	2 7·6" 8 6·4"	7½" 6½" to 5"	6 3·9" 26 1·4" to 2·5"	6" to 4"	5" to 2"	2"	The armour is distributed in the same manner as in the *Montcalm*. All the ammunition supplies are protected.
17 18 19 20	Jules Ferry Léon Gambetta Victor Hugo Jules Michelet	12,351	22·0	1901 to 1905	4 7·6" 16 6·4"	8" or 6" 5"	22 1·8" 2 1·4"	6¾" to 4"	5" to 3"	2"	Armour similar to the *Aube*. Double gun turrets for 12 6·4". All the ammunition supply is protected.
21 22 23	Ernest Renan Edgar Quinet Waldeck Rousseau	13,427 to 13,780	23·0	1906 to —	4 7·6" 12 6·4"	8" 5½"	22 to 26 of 1·4" to 3·9"	6¾" to 4" 6½" to 3½"	5" to 3" 5" to 2"	2" 2½"	Closely resemble the *Jules Ferry*.

APPENDIX I (*continued*).—Armoured Cruisers.

GERMANY.

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
1	Fürst Bismarck ..	10,520	19·0	1897	4 9·4″ 12 5·9″	7¾″ and 4″	10 3·4″ 10 1·4″	7¾″ to 4″	—	3″	Complete belt, and ammunition supply protection.
2 3 4	Prinz Heinrich .. Prinz Adalbert .. Friedrich Carl ..	8,885	20·3	1901 to 1902	2 9·4″ 4 8·2″ 10 5·9″	6″ and 4″	10 3·4″ 12 3·4″ 10 1·4″	3″ to 4″	4″	1″ to 2¾″	Complete belt. Side armour from foremost to after gun supply, and to the height of the main deck. Above this is armour to the upper deck, covering 6 5·9″ guns, and above this the four upper-deck 5·9″ guns are mounted
5 6	Roon .. .. Yorck	9,348	21·2	1903 to 1904	4 8·2″ 10 5·9″	6″ and 4″	12 3·4″ 10 1·4″	4″ to 3″	4″ to 6″	1·6″ to 2¾″	Complete belt. The side armour up to the main deck extends from the foremost to the after end of spar deck; the bow and stern guns have ammunition supply protection
7 8	Gneisenau .. .. Scharnhorst ..	11,420	22·5	1906	8 8·2″ 6 5·9″	6¾″ (?6″)	20 3·4″	3″ to 6″	4¾″ to 6″	1·5″ to 2″	Same as *Roon*.
9	E.	14,760	22·5	—	8 11″ (?)	—	(?)	—	—	—	Same as *Roon*.
10	F.	Programme 1907-08. Details not known.									

APPENDIX I (*continued*).—ARMOURED CRUISERS.

ITALY.

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
1	Marco Polo ..	4,511	19·0	1892	6 5·9″ 10 4·7″	4″	2 2·9″ 9 2·2″ 4 1·4″	4″	4″	1″	Belt a little more than half the length of ship; side armour from a little abaft the foremast to the mainmast and to the height of upper deck. Forecastle and after guns have unprotected ammunition supplies.
2 3	Carlo Alberto .. Vettor Pisani ..	6,396	20·0	1896	12 6″ 6 4·7″	6″ and 4½″	2 2·9″ 10 2·2″ 10 1·4″	4½″ to 6″	6″	1½″	Complete belt. Side armour for two-fifths of the length, and carried up to the upper deck. The ammunition supply of the foremost and after gun unprotected.
4 5 6	Giuseppe Garibaldi Francesco Ferruccio Varese	7,294	20·0	1899	1 10″ 2 8″ 14 6″	6″	10 2·9″ 6 1·8″	4·5″ to 6″	6″	1½″ to 2″	Complete belt. Side armour above belt from the foremost to after gun—*i.e.*, a little over half the length of ship, and carried to upper deck.
7 8 9 10	San Giorgio .. San Marco .. .. Pisa .. .. Amalfi	9,830	22·5	Bldg.	4 10″ 8 8″	7″ and 6″	16 3″ 8 1·8″	3½″ to 8″	7″	1¾″	Complete belt. Side armour from stem to after gun up to the main deck, and to the upper deck from the second to third funnels. Ammunition supply protected.

APPENDIX I (*continued*).—Armoured Cruisers.

JAPAN.

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
1 2	Asama .. .. Tokiwa	9,700	22·1	1898	4 8" 14 6"	6"	12 12-prs. 8 2½-prs.	7" to 3½"	5"	2"	Complete belt. Side armour above belt for little less than half the ship's length. Ammunition supply of bow and stern guns not protected.
3 4	Yakumo .. .. Adzuma — ..	9,850 9,400	21·0 21·0	1899 1899	4 8" 12 6"	6"	12 12-prs. 8 2½-prs.	7" to 3½"	5"	2½"	Complete belt. Side armour above belt from bow to stern gun and to height of main deck.
5 6	Iwate .. .. Idzumo	9,750	21·7 22·0	1900 1899	4 8" 14 6"	6"	12 12-prs. 8 2½-prs.	7" to 3½"	5"	2½"	Same as *Yakumo.*
7	Aso (late Bayan) ..	7,725	22·0	1900	2 8" 8 6"	6·7" and 3"	20 2·9" 20 3-prs.	8" to 3"	3"	2"	Complete belt. Side armour above belt from stem to mainmast up to the main deck, and to the upper deck from second to fourth funnel.
8 9	Nisshin .. .. Kasuga	7,294	20·0	1903 1902	4 8", 14 6" 1 10", 2 8", 14 6"	6"	10 3" 6 1·8"	6 to 4"	6"	1½"	Complete belt. Side armour above belt from bow to stern gun and up to the upper deck.
10 11	Tsukuba .. .. Ikoma	13,750	20·5	1906	4 12" 12 6"	7"	12 4·7" 2 12-prs.	7" to 5"	—	—	Details not known.
12 13	Kurama .. .. Ibuki	14,600	21·2 to 22·0	Bldg.	4 12" 8·8"	Details not known.					

APPENDIX I (*continued*).—ARMOURED CRUISERS.

RUSSIA.

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
1	Pamyat Azova ..	6,734	18·8	1888	2 8" 13 6"	3" and small	7 3-prs. 8 smaller	9"	—	$2\frac{1}{2}$"	Belt for five-eighths of the length of ship. No ammunition supply protection.
2	Rossiya	12,195	20·0	1896	4 8" 22 6"	2"	15 12-prs. 2 3-prs.	10" to 5"	4"	$2\frac{1}{2}$"	Belt for about seven-tenths of the length, raised in wake of the engine cylinders. Ammunition supply unprotected.
3	Gromoboi	12,359	20·0	1899	4 8" 22 6"	6" and $4\frac{3}{4}$"	19 12-prs. 6 3-prs.	6"	$4\frac{3}{4}$"	3"	Belt for about two-thirds the length. Side armour above belt for half the length carried to the upper deck.
4 5 6	Admiral Makarov .. Pallada .. .. Bayan	7,900	21·0	1906 Bldg.	2 8" 8 6"	$5\frac{3}{4}$" and 3"	20 12-prs. 4 6-prs.	$6\frac{3}{4}$" to 4"	3"	2"	Distribution not known.
7	Rurik	15,000	21·0	Bldg.	4 10" 8 8"	8" and 7"	20 4·7" 4 3-prs. 8 smaller	3" to 6"	3"	$1\frac{1}{2}$"	Distribution not known.

APPENDIX I (*continued*).—ARMOURED CRUISERS.

UNITED STATES.

No.	Name.	Displacement.	Speed.	Date of Launch.	Heavy and Medium Guns. Size.	Heavy and Medium Guns. Protection.	Light Guns.	General Protection. Belt.	General Protection. Side.	General Protection. Decks.	General Description of the Protected Areas.
1	New York	8,200	21·0	1891	6 8″ 12 4″	7″ and 4″	8 6-prs. 2 1-prs.	4″	—	3″ to 6″	Complete belt. Ammunition supply unprotected.
2	Brooklyn	9,215	22·0	1895	8 8″ 12 5″	8″ and 5½″	12 6-prs. 4 1-prs.	3″	—	3″ to 6″	Belt extends over half the length of the ship. A complete protective deck.
3 4 5 6 7 8	Colorado .. .. California .. .. Maryland .. .. Pennsylvania .. South Dakota .. West Virginia ..	13,680	22·0 to 22·4	1901 to 1902	4 8″ 14 6″	6″ and 5″	18 14-prs. 12 3-prs.	6″ to 3½″	5″	4″	Complete belt. The side armour above belt extends from a little abaft the foremast to the mainmast, and is carried to the upper deck.
9 10 11	Charleston .. .. Milwaukee .. .. St. Louis	9,700	22·0	1904	14 6″	4″	18 14-prs. 12 3-prs.	4″	4″	3″	Belt extends a little less than half, and side armour a little less than one-third of the ship's length, rising to the spar deck. Ammunition supply to bow and stern guns not protected.
12 13 14 15	Tennessee .. .. Washington .. North Carolina .. Montana	14,500	22·0 to 22·5	1904 to —	4 10″ 16 6″	9″ and 5″	22 14-prs. 12 3-prs.	6″ to 3½″	5″	3″	Complete belt. Side armour above belt from bow to stern gun, and to the height of the spar deck.

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